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The CHEMICAL AGE

OL LX | 30 APRIL 1949 | No 1555

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IN THIS ISSUE

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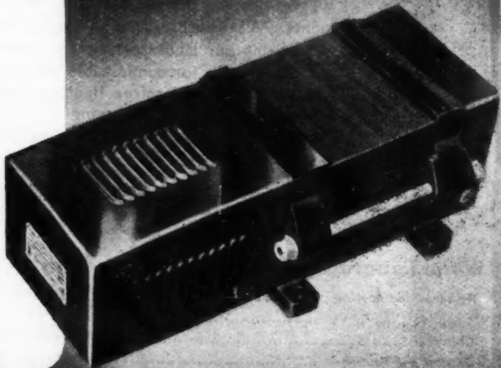

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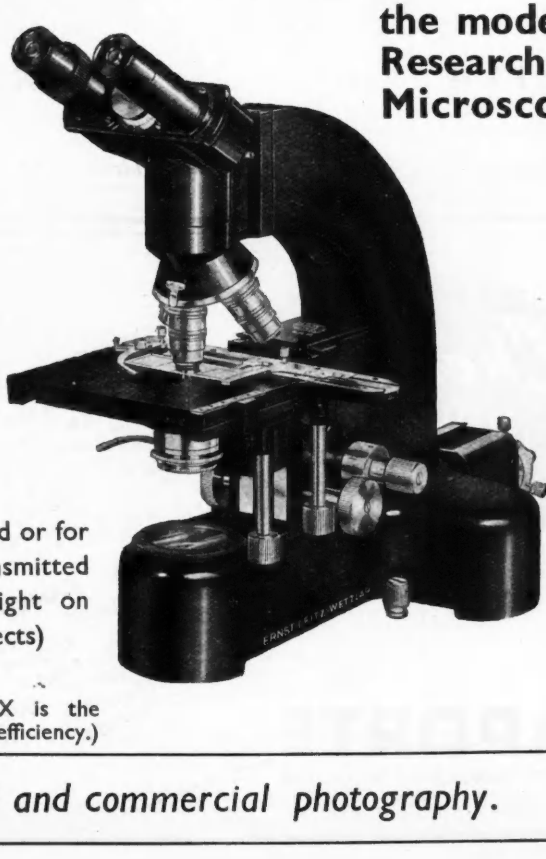

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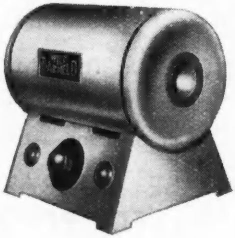

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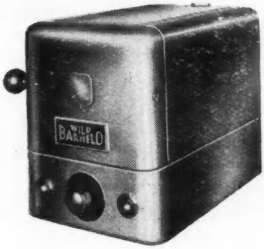

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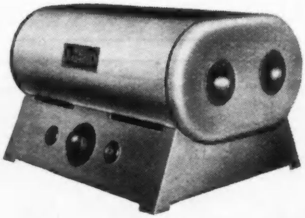

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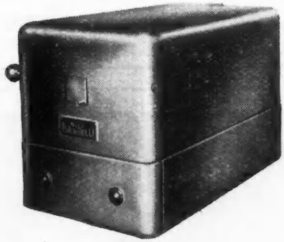

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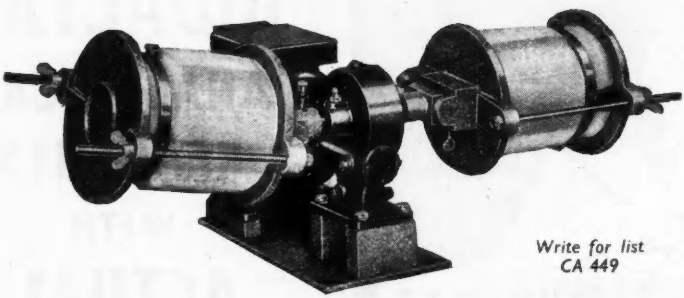

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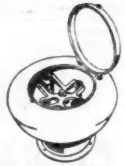

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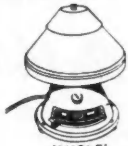

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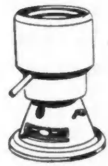

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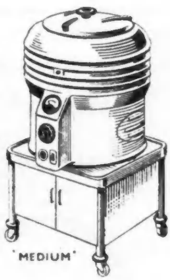

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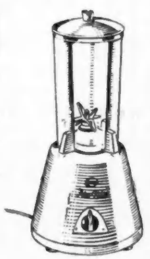

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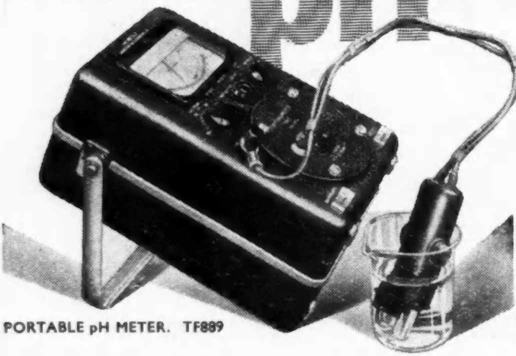

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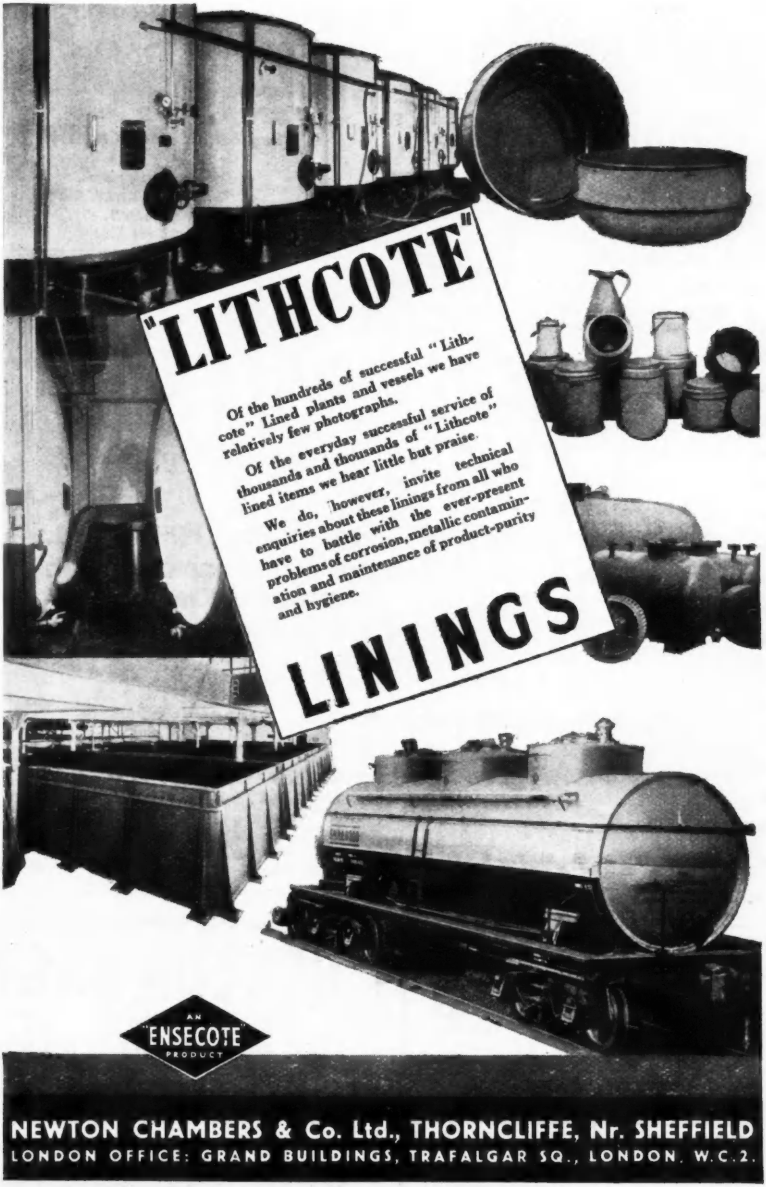
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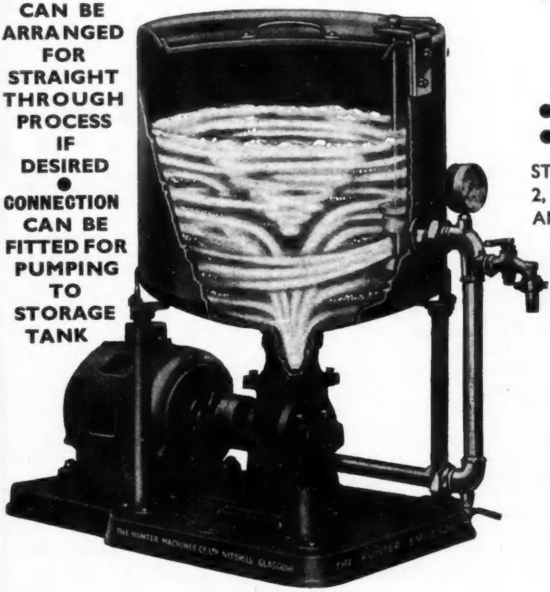

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A Lesson from Australia

THE continuing control of science and of most scientific administration by scientists has been so well established for so long that few in this country are prepared to recognise that any fundamental change could feasibly upset the existing order. There is a very strong possibility that they are right, and all who are conscious of what might be the dissipation of enterprise and discouragement were the alternative to be true will fervently hope that they are.

That this kind of speculation, which few openly discuss, is something more solid than a suitable theme for academic minds is evidenced by what is now taking place in Australia. That continent is some 13,000 miles distant, its government traditions are considerably more communal and "authoritarian" than most British governments of the past, and its scientific development has not been buttressed by institutions which have wielded authority for a century or so. Because of this and other considerations of the same sort most of us are unwilling to draw parallels between the uneasy juncture which has now been reached in Australia and the evidence which has been abundant here since the war of the Government's desire to play a more decisive part in science affairs.

Whether it is true or not that "it can't happen here," it is worth while to look at what has been the course of events in Australia which has just culminated in the repeal of the Science and Industry Research Act. That was the instrument for which Viscount Bruce was responsible in 1926, which gave authority and impetus to the progressive minds in Australia to recognise the existing Commonwealth Institute of Science and Industry on a much broader basis as the Council for Scientific and Industrial Research. In the 23 years of its existence that council has shown itself as ready as is its larger counterpart in the United Kingdom, the Department of Scientific and Industrial Research, to direct all its constantly growing capacity for research to the needs of Australian industry. That it has served generously and effectively is not denied even by those who have now contrived, "in the public interest," to strip it of the authority conferred by the 1926 Act and have proceeded to substitute the Science and Industry Research Act, 1949. A possible result of these two moves is the conversion of the CSIR from a more or less autonomous body into something which could be indistinguishable from some cumbrous Government department. There are good grounds for disbelieving that so enterprising a body will be brought to that dire extremity, and the best of these is the character of some of the scientists who supplied the initiative of the CSIR in recent years. None of them is of the cast

On Other Pages

of mind which accepts the philosophy whose outward evidences are red tape and the rubber stamp. There is however the immediate prospect that they will need all their powers to preserve for the CSIR a field for independent action in the interests of science and industry.

It is instructive to recall the events from which all this has arisen. Towards the end of last year, the passing of the Public Service Act, No. 2, 1948, made it possible to transfer, by authority of public proclamation, any of the work of the CSIR to any State department working under the Public Service Board (THE CHEMICAL AGE, *60*, 109). The other legislative changes which have occurred so soon after show that this was not merely a general safeguard. All the accustomed powers and functions have now been removed from the CSIR, which now serves only in an advisory capacity. Overshadowing it, a new body has been set up, the Commonwealth Scientific and Industrial Research Organisation, with an executive of five to be appointed by the Governor-General. Three are to "possess scientific qualifications." The relationship between the CSIRO and the Government is made uncomfortably clear in several clauses of the Act. One (Clause 9 (2)) says that the body "shall exercise its powers and functions in relation to any matter referred to it by its Minister." While the executive will be empowered to appoint staff, "the selection of persons . . . shall be made in accordance with such requirements as the Public Service Board determines." These and nearly all other decisive functions are henceforth subject to the Board's approval. Equally worth noting, is Clause 31, stipulating that no one associated with the organisation shall, "except in the course of his duty . . . or with the approval of the executive, disclose any information concerning the work of the organisation or the contexts of any document in the possession of the organisation—Penalty: Imprisonment for two years."

The opportunity has been taken also to effect certain other minor changes which experience has shown to be desirable; but it is difficult at this stage to predict just how the new legislation as a whole will affect established scientific activities. The implications are unmistakable and it cannot be disguised that they are disconcerting. If these new powers were fully implemented the prospects for continued individual enterprise in Australian research would indeed be gloomy. The sequel need not be disastrous, but it is known that in some quarters the position is regarded with a great deal of justifible anxiety.

NOTES AND COMMENTS

Technical Efficiency

THIS issue of THE CHEMICAL AGE presents the annual review of scientific instruments and laboratory equipment and, coinciding with the eve of the British Industries Fair, it takes the opportunity of presenting a preliminary summary of some representative items of new equipment and chemicals to be shown in London and Birmingham. It is in effect the fullest summary of technical and scientific supplies it has been possible to assemble in the past 12 months; it may well serve to increase the technical efficiency of some of the industries upon which the success of all BIFs so closely depends.

Hybrid Science No Longer

THE turn of the tide which recent events are bringing about in chemical engineering, as a science and as a profession, gave good grounds for satisfaction reflected by speakers, not exclusively chemical engineers, at a dinner in London last week. The Institution of Chemical Engineers— the hosts—had the stimulus of hearing the congratulations of such disinterested and discerning observers as Sir Charles Darwin, director of the National Physical Laboratory, and Great Britain's director of atomic energy, Sir John Cockcroft, on the widened prospects and prestige for chemical engineering conferred by improving training facilities, and in particular by the acceptance by the Department of Scientific and Industrial Research of the principle that chemical engineering is worthy of a research section of its own within the DSIR. So passes the tradition, whose ghost was recalled by Sir Charles Darwin, which dubbed the chemical engineer a hybrid—neither a chemist nor an engineer.

Hint to Oxford

THE informality which has cloaked the student's approach to chemical engineering at some stages in its long sojourn in the wilderness is admitted to have been among the factors which combined to withhold from the science the recognition that its indispensable contribution to chemical progress merited. That was the philosophy, recalled by Sir Charles Darwin, "that you could start knowing a lot of chemistry and graft a little engineering on that, or know a lot of engineering and mix a little chemistry with that." It was linked with the fantastic notion that the student could do the whole job in three years, regardless of the fact that in some other countries the student course lasted twice that time. The current estimation that it required four years, although inadequate, was recognised by the distinguished physicist as a substantial step in the right direction. The president, Mr. Herbert Cremer, who has been fairly awarded most of the credit for procuring honourable recognition for chemical engineering, has now had the satisfaction of hearing substantially his own views regarding the need for a fuller and more liberal education for all future chemical engineers championed spontaneously by the physicists. Cambridge University, observed Sir John Cockcroft, had set up a school of chemical engineering. If Oxford followed suit he felt they could consider chemical engineering " was really established."

London Colour Chemists

IN sharp contrast with the lukewarm interest which some professional associations seem to inspire, the attitude of members towards the London section of the Oil and Colour Chemists' Association is almost exemplary. Oil and colour chemists exhibit a readiness to accept office, which is conspicuously not the distinguishing mark of all association members and the London group appears to have a more lively appreciation of their obligation to train and help the young recruits than is common. The evidence of this was apparent at last week's meeting of the London section—increased by 54 members since 1948—in the presence of 12 willing nominees to fill two vacancies on the committee, and in the report on an extensive educational programme which has been carried out during the year. The value and progressive character of that programme was marked by its inclusion of the series of post-graduate lectures relating current progress in radioactivity techniques to inorganic chemistry, given by Prof. H. J. Emeléus—some of which were summarised here. The value of this London

enterprise is recognised in the fact that this post-graduate training project is now to have the backing of the association as a whole and its scope is to be greatly extended.

Comparing Notes on Steel

REGARDLESS of the extraordinary production achievements in British steel, the habit persists of drawing comparisons with the vast American steel industry which obscure the true perspective of the two great undertakings. Now, a more objective view is beginning to appear in the impressions of the 16 British steel workers and executives who have now completed their tour of inspection in America sponsored by the Anglo-American Council on Productivity. The workers were agreed that "Britain could not perform its true function in the present field if we were to imitate all features of American production." They also noted that American methods tended to too much uniformity and that there was not enough lattitude for skilled workers. None the less, Mr. F. A. Martin, of Sheffield, leader of the British team, told a Press conference in Washington, "we intend to streamline our rough production corners on the basis of what we have seen in American foundries." The visitors were impressed by the "safety consciousness" of U.S. workers. "The Americans," they said, "are ahead of us on X-ray examinations of workers subject to occupational hazards at work. Everyone wears goggles at the machines—you must wear goggles to walk through the plant. Americans use far more exhaust fans in their factories than we do." Mr. Ben Travis, a Sheffield moulder, said he believed that at present England had better labour-management relations.

British Participation in Ceylon's Chemical Projects

A MEMBER of the Power Gas Corporation, Ltd., of Stockton-on-Tees, England, Mr. T. H. Riley, will visit Ceylon shortly in connection with investigations that are being made by the Minister of Industries and Industrial Research, Mr. G. G. Ponnambalam, for the establishment of a fertiliser factory in Ceylon. The corporation is the agent of the Government of India for the building of the large fertiliser factory at Sindri in Bihar. The Ceylon proposal—on similar lines—is to establish a fertiliser plant for the production of ammonium sulphate. This might enable to be retained within the island the Rs. 20 million yearly which is spent on the importation of fertilisers from abroad.

The responsibilities for designing, constructing and equipping the Ceylon plant will be shared by three companies, of which the Power Gas Corporation will be principally concerned with the facilities for balanced production of hydrogen and nitrogen. The Chemical Construction Corporation, of America, will attend to the plant necessary to synthesise hydrogen and ammonia and finally produce ammonium sulphate. The Engineering Construction Corporation will be responsible for the engineering aspects of the project.

Mr. G. G. Ponnambalam, who returned from India last week, proposes to recommend to the Government the immediate commencement of operations for the exploitation of ilmenite deposits in the island with a view to putting them to the fullest use. The Minister went to India with the Government mineralogist, Mr. L. J. D. Fernando, to examine the working of ilmenite deposits on the Travancore beach in South India, with a view to ordering the necessary machinery for exploiting the rich sands at Pulmoddai, near Trincomalee, in Ceylon.

Ceylon's sands are richer in mineral resources than those of Travancore in that they have a larger percentage of minerals, stated Mr. Ponnambalam. Of these minerals, ilmenite is of the largest commercial value. Although the percentage of ilmenite is higher in Ceylon than in Travancore, the titanium content in the former is about 52 per cent as against 58 per cent in the latter.

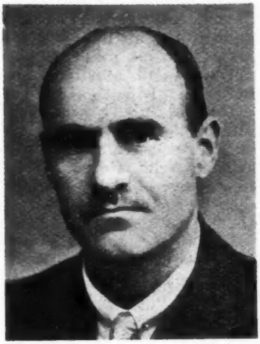
There are several factories in Travancore exploiting ilmenite deposits, run by private firms, and one of them has entered into negotiations with the Travancore Government for the sale of its entire plant and machinery.

A further question was whether Ceylon should not process ilmenite into titanium dioxide, for which there is considerable demand in America and Europe. While it would be easier to sell ilmenite, there was a great future for titanium in South-East Asia.

INSTITUTION OF CHEMICAL ENGINEERS

Interpretation of Scientific Knowledge

Mr. H. W. Cremer, retiring president of the Institution of Chemical Engineers (left) whose address covered the application of scientific discovery to the daily task, and Prof. D. M. Newitt (right), who was elected president for the coming year, at the last meeting of the institution



THE inability or unwillingness of some who pioneer new scientific conceptions to present the ideas in specific and intelligible terms to those responsible for interpreting them in industrial applications is a characteristic weakness of the present system of research and industrial relations. The research scientists, and especially those concerned with pure research, are too often so immersed in their own circumscribed spheres as to fail to appreciate the significance of their work in the broader fields.

Those criticisms, representing the highly informed view of one who has been intimately associated with both spheres for many years, were given by Mr. H. W. Cremer, retiring president of the Institution of Chemical Engineers, at the corporate meeting of the institution in London last week at which the election of Prof. D. M. Newitt as president for the coming year was announced.

Mr. Cremer, who was delivering the presidential address, his second, explained that he was especially concerned with the interpretation of science to those who, like chemical engineers, were required to apply scientific discovery as part of their daily round.

Out of Touch

It was a matter of general consent that not only the origin of new scientific discoveries, but the making known of them, were not infrequently in the hands of persons who were so immersed in the details peculiar to the rather circumscribed field that they did not readily comprehend the significance of their work outside that field. That should not occasion surprise, but in a world in which pure and applied science were becoming more and more intermingled too much detachment on the part of persons engaged in fundamental research might easily lead to a selfish and unreal state of mind.

Applying Knowledge

The greater part of academic research in pure science did not have as its primary motive the desire to apply the knowledge gained for any pre-determined industrial purpose. Yet only in that way could a suitable environment exist in which certain types of mind could operate and the genius born of them flourish. It was unfortunate that people who enjoyed that state sometimes gave the impression that they were saying "I hate the uninitiate crowd and bid them avaunt."

That might be all very well for the person who was solely concerned with research and was under no obligation to communicate what he had discovered, but generally in academic circles teaching and research went hand in hand. By no means all who accepted the responsibility of communicating their knowledge to others could bring themselves to do so in a manner which could be comprehended by those who were less well versed than they in the intricacies of the subject.

Another source of new knowledge was Government-sponsored research establishments. He had been closely associated with the work of a number of them, and it did not detract from his high appreciation of the value of that work if he offered friendly

criticism regarding their willingness to communicate.

Part of their work was to provide for the requirements of the industrial developments of the future. In that their work was not unlike that of the more recondite researches at universities and required an intellectual calibre no whit less. Consequently a similar mentality was induced, the spirit of introspection and aloofness from the common herd.

He had talked with many such persons, and he thought they tended to stop short of their proper goal, being satisfied to stay content as originators of new knowledge and new ideas, but loath to interpret them sufficiently to those who were waiting to apply them.

Chemical engineers had little time, if any, in which to assimilate erudite pronouncements and in which to elucidate them—they had more than enough troubles and anxieties as it was.

The Written Word

On the subject of written communications, Mr. Cremer deplored the fact that for so long it had been left to those outside Britain to furnish the written words which students were obliged to use. Until they themselves produced a full measure of scientific communication, books or papers, which voiced their own ideas and their own point of view, as chemical engineers they would have their critics at home as well as abroad.

A good deal of suspicion was still entertained about their profession in various quarters, some of them rather surprising quarters and certainly very important ones. They had not "communicated" sufficiently, either the reasons for their beliefs, or the fact that they were not attempting to usurp another man's job.

Finally they must address themselves to the very difficult task of describing a "chemical engineer" with much greater succinctness and definition than they had done so far. The original description approved by their first council had outworn its usefulness. Now, its very grandiosity was a positive danger to them.

Officers and Awards

Included in the business of the 27th annual meeting was the election as a vice president of Mr. M. B. Donald on his retirement from the position of joint honorary secretary (with Mr. L. O. Newton). Three other vice-presidents elected were Messrs. A. E. Leighton, J. McKillop and J. A. Oriel, and the following were elected to the council: Messrs. G. Brearley, R. Edgeworth Johnstone, C. S. Robinson and V. W. Slater, with S. R. Tailby as associate member.

The institution's indebtedness to the retiring hon. sec. was acknowledged by the presentation to Mr. Donald of a grandfather clock and a cheque.

Medals and certificates for 1948 were presented as follows: Osborne Reynolds Medal to Mr. H. W. Thorp for his valuable services to the institution, particularly as hon. editor.

The Moulton Medal to Mr. W. S. Norman (associate member) for his paper on "Fluid Friction, Heat and Mass Transfer in Turbulent Flow," read before the North-Western branch of the institution.

The Junior Moulton Medal to Mr. H. Winning (graduate) for the paper on "Some Aspects of Plate and Frame Filtration."

The William Macnab Medal was presented to Mr. H. W. Balls for the best set of examination papers submitted in the 1948 associate-membership examination.

Many figures distinguished in chemistry, physics and engineering were among the guests of the institution at the annual dinner at the Mayfair Hotel the same evening.

Nuclear Power

Sir John Cockcroft, director of the Atomic Energy Research Establishment, spoke of the closer integration which he expected to see between chemical engineers and the processes of nuclear energy. If nuclear power was to become of use, he said, the chemical engineer would have to find means of extracting uranium from rocks and shales and the other sources in which it occurred. That was easy if enough money was spent, but that would not produce cheap power. It was the business of the chemical engineer to find out how to do the job economically.

That was a preliminary exercise and if the chemical engineer solved it there was a much more difficult one awaiting him. Although we had a moderate amount of primary nuclear fuel in the world, we had to be able to provide secondary nuclear fuel and had therefore to call on the chemical engineer to separate it from the primary fuel from which it had been made.

There the problems were much more severe, but he thought that after another five years' work from the chemical engineer the position would be much clearer. In spite of that, however, he was not going to make any promises about nuclear power.

One thing he thought was quite clear to those who looked on the chemical engineer from the outside—that his position and importance in the world was increasing.

CHEMICAL EXPORTS RALLY

Improvement on February Totals

CHEMICAL exports from the U.K. in March (which was a longer working month) reached a value of £7,517,228, compared with £6,651,739, the previous year. This figure was £833,769 better than February, but failed to reach the high level of January. These figures are given in the latest issue of *The Trade and Navigation Accounts of the U.K.* (HMSO, 6s. 6d.) The total value of £22,520,067 for the first three months of the year shows that a steady improvement has been maintained during the past three years, exports for the first quarter of 1948 being £19,104,597 and £15,273,730 for 1947. There were declines in cresylic acid, collodion cotton and caustic soda, but increases in plastic materials and gas and chemical machinery. Individual categories of exports and imports are shown in the accompanying tables.

CHEMICAL EXPORTS

	Mar., 1949	Mar., 1948
	Cwt.	Cwt.
Formic acid	3,074	3,239
	Lb.	Lb.
Salicylic acid and salicylates	186,440	107,814
Value of all other sorts of acid	£88,230	£66,666
	Tons	Tons
Aluminium oxide	1,063	666
Sulphate of alumina	2,975	1,960
All other sorts of aluminium compounds	1,335	431
Ammonium sulphate	9,123	13,336
Ammonium nitrate	7,632	8,140
All other sorts of ammonium compounds	1,274	3,603
	Cwt.	Cwt.
Bleaching powder	41,219	21,219
All other bleaching materials	9,648	9,796
	Gal.	Gal.
Cresylic acid	78,794	184,845
Tar oil, creosote oil, anthracene oil, etc.	4,103,741	2,856,240
Value of all other sorts of tar oil	£25,722	£33,388
	Cwt.	Cwt.
Collodion cotton	1,831	1,983
	Tons	Tons
Copper sulphate	3,341	3,900
	Cwt.	Cwt.
Disinfectants, insecticides, etc.	49,099	52,667
	Tons	Tons
Fertilisers	2,143	3,184
	Cwt.	Cwt.
Nickel salts	4,515	4,248
Lead acetate, litharge, red lead, etc.	7,292	11,603
	Gal.	Gal.
Tetra-ethyl lead	120,348	210,722
	Tons	Tons
Magnesium compounds	629	912
	Gal.	Gal.
Methyl alcohol	10,428	5,202
	Cwt.	Cwt.
Potassium compounds	6,000	9,588
	Tons	Tons
Salt	17,781	16,671
	Cwt.	Cwt.
Sodium carbonate, etc.	383,905	312,354
Caustic soda	126,383	186,965
Sodium silicate	33,931	12,924
Sodium sulphate	16,430	4,327
All other sodium compounds	79,191	83,431
Cream of tartar	410	106
Tin oxide	942	777
	Tons	Tons
Zinc oxide	1,337	943
Total value of chemical manufactures, excluding drugs and dyestuffs	£3,952,331	£3,689,370
	Oz.	Oz.
Quinine and quinine salts	202,100	87,308
	Lb.	Lb.
Acetyl-salicylic acid	141,031	63,492
	100 International units	100 International units
Insulin	752,611	363,151
	Mega units	Mega units
Penicillin	449,625	326,857
Total value of drugs, medicines and preparations	£1,678,753	£1,229,878
Total value of dyes and dyestuffs	£715,132	£564,517
	Cwt.	Cwt.
Plastic materials	34,477	28,152
Value	£425,048	£339,149
	Cwt.	Cwt.
Chemical glassware	1,238	1,597
Value	£46,366	£49,488
	Cwt.	Tons
Fans	4,978	97
Value	£149,137	£67,181
	Cwt.	Tons
Furnace plant	7,175	570
Value	£95,236	£84,532
	Cwt.	Tons
Gas and chemical machinery	26,299	435
Value	£323,923	£66,467

CHEMICAL IMPORTS

	Mar., 1949	Mar., 1948
	Cwt.	Cwt.
Acetic acid	—	15,691
Boric acid	8,300	10,760
All other sorts	5,498	3,231
Borax	30,041	64,020
Calcium carbide	2,188	12,331
Coal tar products, excluding benzol and cresylic acid	—	5,134
Cobalt oxides	448	613
	Tons	Tons
Arsenic	105	100
Fertilisers	35,894	39,095
	Lb.	Lb.
Iodine	132,126	66,050
	Cwt.	Cwt.
Potassium chloride	401,441	548,966
Potassium sulphate	55,364	32,500
All other potassium compounds	4,033	3,197
Sodium nitrate	181,342	59,820
All other sodium compounds	2,770	733
Carbon blacks (from natural gas)	39,848	90,850
Total value of chemicals, drugs, dyes and colours	£2,467,393	£2,749,460

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Oil and Colour Chemistry

OCCA Exhibition of Materials

AN exhibition of plant and materials for the paint, varnish, printing inks and allied industries added interest to the annual general meeting in London last week of the London section of the Oil and Colour Chemists' Association.

The annual report revealed that membership in 1948 had increased by 54.

The post-graduate lectures, which had become a recognised feature of the section's activities, were to be taken over by the council of the association at an early date and extended in their scope, it was announced by Mr. R. Ledwith, a past chairman, who proposed the adoption of the report. The London section would continue to act as stewards for the association in the conduct of this scheme.

Mr. L. O. Kekwick was elected chairman of the section for the ensuing year in succession to Mr. David E. Roe, who retires from the post which he has held for two years.

The following officers of the section were elected: Hon. secretary, Mr. H. C. Worsdall; hon. treasurer, Mr. H. A. Newnham; hon. publications secretary, Mr. R. F. G. Holness; hon. publicity officer, Mr. Neil R. Fisk; chairman of programmes committee, Mr P. J. Gay; hon. auditor, Mr. J. L. Hawkie.

As the result of a ballot to fill two vacancies on the committee, Dr. Chatfield and Mr. Rupert Law were elected.

ISRAEL'S INDUSTRIAL PLANS

WORK has recently been started on Israel's third glass factory, covering an area of about 4500 square metres in Haifa Bay. Total cost is estimated to amount to £350,000. The new factory is to be equipped with very modern machinery, imported from the U.S.A. and Canada. Productive capacity is to aggregate 2.5 million square metres of sheet glass annually, and it is anticipated that a large part of the output will be exported to neighbouring countries. The addition of this new unit will quadruple the country's present output of sheet glass.

At present Israel's glass factories rely on Belgian sand as their basic material, but it is reported that a deposit of suitable sand has been discovered in the Negev.

A number of interesting industrial schemes are to be carried out in Israel. Based on a new process developed by the Weizmann Institute at Rehovoth for the manufacture of synthetic resins from ricinus oil, an U.S. group intends to erect a factory at a cost of $3 million.

Tin Metal Allocations

Quantities for First Half of 1949

THE Ministry of Supply announces that the Combined Tin Committee has made the following final allocations of tin metal for the first half of 1949. The quantity of metal allocated for that period totals 61,475 (long) tons, which includes new allocations totalling 17,150 tons. Tonnages finally allocated are as follows:—

Australia 300, Austria 300, Brazil 900, Canada 2750, Ceylon 17, Chile 100, Czechoslovakia 900, Denmark 400, Egypt 300, Finland 150, France 6050, Germany-Bizone 1500, Germany-French 460, Greece 100, Hong Kong 150, Hungary 300, India 936, Ireland 42, Israel 60, Italy 1000, Japan 2000, Korea 10, Mexico 80, Norway 200, Pakistan 500, Poland 1615, Rumania 275, Spain 350, South Africa 280, Sweden 300, Switzerland 400, Syria 50, Turkey 500, U.S.A. 37,500, Jugoslavia 400, *others 300.

Supplies may be obtained from the United Kingdom on behalf of the United Kingdom, Malaya, Hong Kong, the Netherlands, Belgium and China. In addition, small demands of certain Latin American and Middle Eastern countries may be met from the above sources and from the United States.

* Latin America, other than Argentina, Brazil Chile, Uruguay and Mexico; the Middle East, other than Egypt, Palestine, Syria and Iran. These countries are normally provided for by individual allocations.

METAL GRINDING REGULATIONS

THE Ministry of Labour announces that it is proposed to make two codes of special regulations amending the Grinding of Metals (Miscellaneous Industries) Regulations, 1925, and the Grinding of Cutlery and Edge Tools Regulations, 1925.

The proposed regulations are the outcome of the decision of the Court of Appeal in the case of Franklin v. Gramophone Co., Ltd. (1948 I.K.B. 542) in which difficulties arose in interpreting the Grinding of Metals (Miscellaneous Industries) Regulations, 1925. In the light of these, the Minister reviewed the regulations, and the Grinding of Cutlery and Edge Tools Regulations, from which similar difficulties are liable to arise.

Copies of the draft special regulations, the Grinding of Metals (Miscellaneous Industries) (Amendment) Special Regulations, 1949, and the Grinding of Cutlery and Edge Tools (Amendment) Special Regulations, 1949, may be obtained from HMSO. Objections to either code by persons affected must be sent to the Minister on or before May 31, 1949.

NEW ZEALAND'S PLASTICS INDUSTRY

Modern Well-Equipped Plant

LIKE many other secondary industries, the manufacture of plastic articles expanded rapidly in New Zealand during the war and post-war years. The first factory commenced phenolic moulding in 1932, and there were now six in operation seven years later. Now plastics are being produced in thirty New Zealand plants which employ some 450 skilled workers. New Zealand is, in fact, a user of moulding powders and machinery on a scale which shows promise of further increase and, because of currency problems, an increasing proportion of some orders may be diverted from Canada and the U.S.A. to this counttry.

These are some of the facts and implications conveyed in a survey by Mr. C. M. Forsyth-Smith, Canadian Assistant Commercial Secretary in Melbourne, in a survey in *Foreign Trade* (Ottawa, *117*, 650) in which he notes that no moulding materials are made locally, all supplies being imported, chiefly from the United Kingdom and Australia. The estimated annual values of raw material requirements of the industry, with sources of supply and uses to which the material is put, are as follows:—

	£
Perspex, obtainable from the United Kingdom and imported in sheet form and fabricated, etc., locally	70,000
Thermosetting moulding powders, obtainable from the United Kingdom and Australia; imported in powder form and compression moulded into various articles in New Zealand	220,000
Thermoplastic moulding powders, obtainable from the United Kingdom; imported in powder form and injection moulded or extruded into various articles in New Zealand	65,000
Thermoplastic moulding powders, obtainable only from the United States or Canada; imported in powder form and injection moulded or extruded into various articles in New Zealand	75,000

Casein is produced locally in limited quantities, but some casein used in the industry is imported from Australia. There is no prospect of additional quantities of raw materials being admitted from Canada, since the plants using Canadian and United States raw materials are adequately supplied, and little expansion in injection moulding and extrusion is expected.

It is hoped, therefore, that there are possibilities that New Zealand may turn to the United Kingdom and other non-dollar sources for further requirements of raw materials.

The compression moulding section of the industry is by far the largest, about 300 presses being in continuous production, the Canadian summary records. Over 4000 articles, covering a wide range, are manufactured by this process. In the custom moulding field a large number of articles are made for use in other industries, principally plants that are sub-units of large manufacturing plants such as producers of electrical goods, etc.

Practically any item within the scope of a compression press can be made, since most local plastic firms have their own die- and tool-making shops. Compression mouldings produced by plasticists for sale on the retail market also cover a wide range, including tableware, builders' hardware, buttons, etc.

The combined capacity of the New Zealand injection moulding industry is greater than that of Australia, and considerable quantities of injection moulded articles are supplied by New Zealand to Australia. Ten injection moulding machines use United Kingdom and United States raw materials and produce combs, toothbrushes, table utensils, etc. New Zealand's total requirements of combs, toothbrushes and men's outerwear, shirt and pyjama buttons are produced locally by the injection method.

Extrusion Methods

Introduction into New Zealand of the extrusion process is fairly recent and is used by six firms. Among the articles produced by this method is a wide range of extruded wires for electrical work and coloured and plain plastic strip for belts, braces, watch straps, etc. Extruded rod and tube is also being manufactured by one firm and exported in large quantities to Australia.

The fabrication of sheet and rod is being carried out fairly extensively by seven New Zealand plants, the most popualr material being perspex, which is imported from the United Kingdom. Radio cabinets, sinks, household trays, table lamps and food containers are manufactured from this material.

The New Zealand plastics industry is well equipped with modern plants and well-trained workers. Most of the larger units arrange for their technical experts to visit European and United States plastic plants regularly in order to keep in touch with the latest developments.

Under the present system of complete protection, the plastics industry is consolidating its position, and it is probable that most plants would be competitive, even if overseas products were allowed free entry, although a few of the marginal plants would find it difficult to operate.

RUBBER HYDROCHLORIDE FILM

The Commercial Manufacture of Pliofilm

THE manufacture of Pliofilm on a commercial scale is now in progress at the new factory of the Goodyear Tyre & Rubber Co. (Great Britain), Ltd., at Bushbury, Wolverhampton, which was officially opened on February 25 (THE CHEMICAL AGE *60*, 271 and 370). Last week, THE CHEMICAL AGE was among those privileged to inspect the series of chemical and physical processes which go to the making of Pliofilm, which in its finished state is a transparent rubber hydrochloride film

Breaking down the crude rubber in a mill

with extremely wide potentialities as a protective packaging material.

In the first process, crude natural rubber of good grade is broken down in a mill, each pound of rubber receiving a minimum of 12 " breakdowns " and 18 complete treatments in the mill. Between each there is a cooling period of at least six hours; identification tags are attached to each batch of milled rubber for strict recording of times and treatments.

On the completion of the milling, the crude rubber is transported to the mixer by overhead conveyor. Mixed with a straight solvent (in practice benzol) it is made up in the mixer to a rubber cement of approximately 20 per cent solids. It is pumped from storage tanks through a scale tank and into three reactors, where it is cooled with refrigerated water prior to reaction with dry hydrochloric gas which is generated in two large adjoining stoneware pots.

A pre-determined amount of gas is added and the rubber is allowed to continue ageing (or reacting) for from four to six hours. During this period, the hydrochloric acid combines with the rubber to give rubber hydrochloride, which is, in fact, Pliofilm. When, after a series of tests, the material is found to have reacted to the degree desired, it is discharged from the reactors and transferred into two nickel-clad steel tanks where the cement is neutralised, heated, and compounded before being filtered.

After compounding, all Pliofilm cement is filtered twice before being used, the first filtration taking place in a 40-plate 24-in. press, through which it is pumped.

Filter cloths of this type cost about £10 per set so that it is economical to maintain a cloth washer and dryer as auxiliary pieces of equipment in which the cloths are prepared for further use. Another piece of equipment, the " quencher," is used to recover solvent from the cleanings of the filter press.

Conversion into Film

The filtered material is next transferred to aluminium storage tanks where an elevated temperature is maintained so that the Pliofilm cement will not begin to solidify, and is filtered once more before entering a " casting unit " which converts the rubber hydrochloride cement to film. Important components of this unit are a spreading knife and a spreading belt, the latter being 165 ft. long and 72 in. wide.

This is an endless neoprene belt which has been coated to render it perfectly level and is adjusted to maintain an exact distance from the knife. The thickness of the film being in the region of .001 in., any change in the distance between the belt and the spreading knife would make an appreciable difference in the thickness of the film.

A small dam built up at the back of the knife holds several gallons of cement, the level of which is controlled by an automatic float. The movement of the belt draws cement under the knife, and the cement dries out to give a film as it proceeds through the cabinet. The knife is adjustable to any degree desired, and the surrounding case is heated to approximately 150°F.

The film is carried on the belt until it is stripped off just ahead of the dam. It is then threaded through the stripped roll assembly and from there under the platform into the dryer case.

This case is heated to 200° F., and as the film passes through it the last small amount of solvent which may be left in the film is removed. There are approximately 250 ft. of film in the dryer, being held at 200° F. for approximately six minutes. As it leaves the dryer the film is wound on to the steel shells, each edge being trimmed so that the film may be wound smoothly. The unit will produce approximately 3000 lb. of Pliofilm per day.

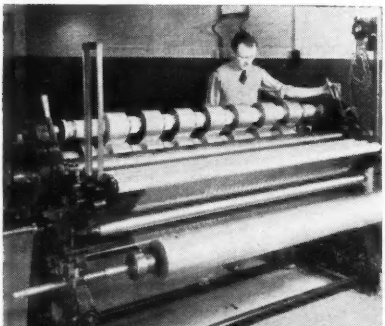
Recovering Solvent

All scrap produced in the casting unit and on the slitting machines is re-dissolved and used again. In fact, the only thing lost in the process is the filter press cake, and the solvent is recovered from that. The panel controlling the recovering of solvent is efficient to approximately 97 per cent of the solvent spread. 22,500 cu. ft. per minute of heated air moves through the dryer case, so that an explosive mixture of air and solvent is never reached.

If for any reason the large fan moving this air should stop, the panel would automatically re-set the valves so that all air exhausted from the case would be blown to the atmosphere with two steam ejectors which are capable of moving 31,000 cu. ft. per minute.

These cases are protected so that in the event of fire 500 lb. of carbon dioxide would be automatically distributed through the case. An additional 500 lb. can be manually introduced into the case. A hand-operated water-sprinkler system is the last resort.

Two large tanks (or absorbers)) are used



Machine for slitting the film ; the knives need to be reground about once an hour

Moist burn and wound dressings wrapped and sealed in Pliofilm for hygienic, protection and retention of their essential moisture

to reclaim solvent, each tank containing 12,000 lb. of activated carbon. The vapour-laden air is blown through the activated carbon which removes the solvent, allowing the stripped air to be discharged to the atmosphere. The solvent is then removed from the activated carbon by steaming, the combined steam vapour and solvent vapour being condensed and run to the decanter, where the solvent and water are separated.

Adsorbing Unit

The two adsorbers work alternately, one adsorbing while the other is steaming. All valves on this unit operate automatically with air pressure at a certain given time as designated by the control panel at the casting unit.

To ensure further that no taste or odour is imparted to Pliofilm, all recovered solvent is re-distilled before being used. Approximately 30,000 lb. of solvent is recovered each 24 hours, and all of this is distilled before being used. About 0.5 million lb. of steam are used each 24 hours, most of it for solvent recovery, which is effected to an overall rate of about 92 per cent.

100,000 cu. ft. per minute of air are introduced into the building. Of this, 60,000 are filtered, so that all air in the spreading area, solvent recovery area, and finished area is filtered. A very delicate job of air balancing is necessary so that the flow of filtered air will always be outward

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Means of Excluding Moisture Vapour

Its Effect on Packaging Materials

THE necessity for the production of moisture-proof packaging, to which attention has been directed by the manufacture of Pliofilm recently, was referred to by Mr. J. L. Denny, of the Packaging and Allied Trades' Research Association, in a talk on "Moisture and the Package," which he gave at the April meeting of members of the Institute of Packaging, held in London.

Mr. Denny maintained that water vapour caused more package troubles than any other single thing. It was impossible to itemise all the commodities liable to deterioration in this way, but it was very large. The method *par excellence* of coping with water vapour, was to use a sealed metal can. This provided an almost perfect barrier and gave considerable mechanical protection against rough handling. Glass, too, provided excellent protection but was somewhat fragile and it was not always easy to get the right closure.

With regard to flexible materials, none gave complete protection against the passage of water vapour. Wooden cases, though not normally providing protection against water or water vapour, could be made efficient by the provision of an adequate barrier inside the case. This was usually a bitumen laminated paper in the form of a large bag. Where the cost could be justified, a soldered metal liner provided first-rate protection.

Moisture vapour was not the only threat to the package; mould also occupied a very high place. Materials like metal or glass were excellent barriers against mould, and it seemed that plastic materials such as polythene, methyl methacrylate, and PVC were not readily attacked. Cellulosic materials, on the other hand, did provide a good substratum, and there were some moulds which would actually destroy cellulose. Unfortunately, there were difficulties in finding a suitable inhibitor since none is the universal panacea against micro-organisms.

For the protection of metal parts there were two or three methods in general use. First there was the lanoline preservative coating, developed during the war, and another was the wrapping of parts likely to be affected in paper impregnated with sodium benzoate. This method was also used successfully during the war. The drawback was that the part to be protected must be in physical contact with the impregnated paper. This was not always possible so one had to turn to what are known as vapour phase inhibitors. These were substances placed inside the package which evaporated slowly, filling the space with a protective vapour.

RUBBER HYDROCHLORIDE FILM

(*Continued from previous page*)

rather than inward. Unfiltered air thus cannot come into any of those three areas.

The finished Pliofilm is removed from the casting unit and transferred to a Camachine, or slitting unit, where it is slit and re-rolled in widths from 1 in. to 60 in. wide. It is then packed and is ready for transport. Some of the film is cut into sheets. Pieces of Pliofilm may be joined by the convenient method of heat sealing, the resulting weld having been proved to be twice as strong as the original material.

One of the primary merits claimed for Pliofilm is its capacity to retain or repel moisture, according to needs; it is considered to be moisture-vapour-water-proof. It has also been found to be resistant to punctures, tears and abrasions, pliable though it is. It is unaffected by atmospheric conditions or normal temperatures and is unharmed by the rigorous processes of forming packaging material into a finished package. It is also resistant to weak acids and alkalis, and such things as grease, mould, oils, and vermin. It is non-explosive, non-inflammable, odourless and tasteless.

Tests have shown that Pliofilm has dimensionable stability through the entire humidity range at ordinary temperatures, but becomes thermoplastic at 225° F. It provides a high degree of preservation to a wide range of articles, including perishable foods.

One of the unusual characteristics claimed for it is its ability when drawn under tension to a thin membrane to hold in moisture, while retaining sufficient gas, such as CO_2, to slow down the metabolism of wrapped fruit or other produce. Pliofilm has been successfully used to contain and preserve frozen foods, meats, cheese, coffee, tobacco, and liquid and semi-liquid products, including oils.

During the second world war, Pliofilm was employed for the packaging of aircraft engines, having been chosen because of its high moisture protective quality, transparency, ability to withstand salt water, and its resistance to oil. These properties and the use of a desiccant such as silica gel were sufficient to protect engines from corrosion. This method dispensed with the long process of degreasing new engines before they were used.

Experimental Heat Exchange

Efficiency Tests of Finned Tubing

EXPERIMENTAL data supporting the belief that finned tubing is about eight times more efficient than plain tubing in heat exchange applications are claimed to have been obtained by the Lehigh University Institute of Research, Bethlehem, Pennsylvania.

Commenting on the co-operative research programme in which the David E. Kennedy Corporation of Brooklyn, New York, is participating, Dr. Darrel E. Mack, of the university's department of chemical engineering, said it was hoped that the test results would lead to the use of finned tubing in entirely new applications.

A 35-ft. test unit had been devised by the institute for rapid determinations on the heating, cooling and refrigerating of air through the use of extended surface tubing.

The unit permitted the introduction of either steam or refrigerant into the proprietary tubing under test, measured the air flow rate and air temperature, determined the amount of moisture in the air, and recorded pressure loss through the coils. Controlled flow of refrigerant was made possible by an adjustable Freon refrigerating unit, and humidity was varied by use of spray humidifiers.

It was necessary to have great variability in the test unit, Dr. Mack explained, because of the widely diverse conditions under which finned tubing was used, such as unit air heaters, air conditioning equipment, and in heat exchangers where space or weight was at a premium.

Scottish Heat Appliances

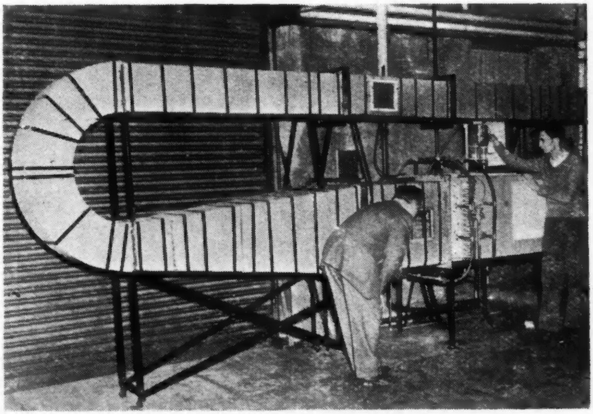
Start of Anglo-U.S. Project

THE official opening of the new Honeywell-Brown, Ltd., plant at Blantyre, last week marks the expansion of the instrument industry in Scotland, where it was already well established pre-war.

This development, which was inspected by Mr. Paul Wishart, vice-president of engineering of the Minneapolis-Honeywell Regulator Co., Ltd., the parent firm, will effect a considerable dollar saving and also develop the export trade in recording and regulating equipment. At present some 70 employees are working at Blantyre but a labour force of 300 is visualised in the near future.

Specialised Instruments

The company will manufacture thermostatic space heating appliances and recording and controlling electronic pyrometers for use in the oil, steel, chemical, ceramic, textile, papermaking and similar industries. It is planned to produce 500 per annum standard units by September next and to raise this to 1000 units per annum. Each unit is worth approximately £400 and represents a considerable dollar economy, and it is intended to export to most European markets. Work began at Blantyre in October of last year and commercial scale production should begin almost at once. In tooling, the company will use some 50 per cent of components imported from the U.S.A. but it is intended ultimately to be quite independent of U.S. supplies.



Dr. Darrel E. Mack, of Lehigh University's department of chemical engineering, makes a check through the observation port of the 35 ft. test unit

AMERICAN BID FOR COAL OIL

First Demonstration Plants Completed

FIRST of their kind in the U.S.A. and regarded as the forerunners of a new basic industry, two new coal to oil demonstration plants are to be put in operation on May 8 at Louisiana, Missouri, the U.S. Bureau of Mines has announced. Erected at a combined cost of $15 million to serve as a proving ground for American coals, equipment, and processing methods, the new plants will employ different processes to convert coal and lignite into the high-quality synthetic liquid fuels which may one day be the means of freeing the U.S.A. from dependence on foreign sources of oil.

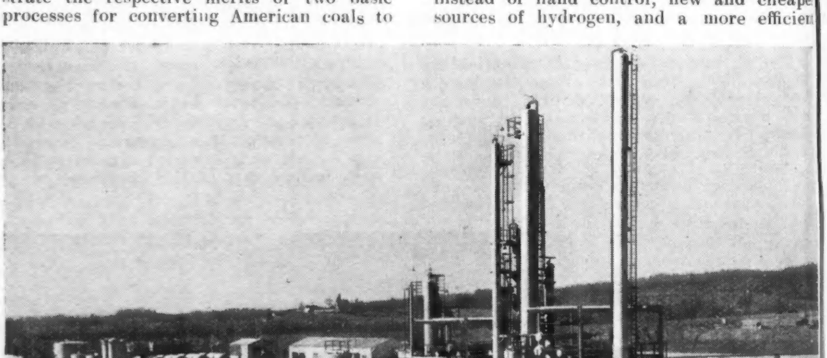
Authorised by the Synthetic Liquid Fuels Act of 1944, the demonstration plants are expected to foreshadow a pattern of engineering and economic knowledge for the establishment of future installations.

According to the Secretary of the Interior, Mr. J. A. Krug, synthetic liquid fuels from coal and oil shale could offer a supply adequate for centuries from known reserves within the U.S.A.

The new synthetic fuel plants will demonstrate the respective merits of two basic processes for converting American coals to oil: (1) The direct hydrogenation o Bergius-I.G. Farben process; and (2) th gas synthesis or indirect Fischer-Tropsc process.

The hydrogenation demonstration plant the first of the new units, now ready t operate, has a production capacity of fron 200 to 300 barrels daily, depending on th coal and catalyst used. Built at a cost o $10 million, the plant was designed for pres sures up to 10,300 p.s.i. in two major opera tions: (1) Liquid-phase hydrogenation which accomplishes liquefaction of the coal and (2) vapour-phase hydrogenation, whic converts the liquefied coal to petroleum an by-products. Chemically, crude petroleu contains more than twice as much hydroge as coal, and hydrogen is added to the co catalytically under high pressure and ten peratures.

Basically, the design of this plant follow that of the German units and many improve ments developed in American researc laboratories have been incorporated. Amon these are the use of automatic contr instead of hand control, new and cheape sources of hydrogen, and a more efficien



U.S. coal hydrogenation plant. The distillation area where the oil products are separated and refined to high quality liquid fuels ranging from aviation petrol to fuel oils for industrial use

utilisation of heat to lower costs.

Difficult problems overcome included the design and fabrication of high pressure equipment new to American manufacturers, development and installation of highly complex instrumentation, and the training of both engineers and operators in techniques foreign to American industrial experience. German scientific and technical personnel, experienced in all phases of European hydrogenation practice, have been of considerable assistance.

Initially, the plant will process western United States coals, which lend themselves well to hydrogenation and subsequently coals from other sections of the country will be tested. Bituminous coals, sub-bituminous coals, and lignites all may be hydrogenated. The production of one barrel of oil requires 0.5 ton of bituminous coal, whereas the requirement for sub-bituminous coal is 0.66 of a ton, and for lignite, one ton.

The By-Products

By-products will include phenols for plastics, " creosote " for wood preservation, solvents for paints, and hydrocarbon gases for heating fuel. Bureau engineers estimate that a commercial coal hydrogenation plant with a capacitty of 30,000 barrrels a day could produce gasoline at a cost of 12 to 15 cents per gal. if no credit is taken for by-products.

Now being constructed by the Koppers Company of Pittsburgh, Pa., at a cost of $5 million, the second of the Bureau's new units, the gas synthesis demonstration plant, is scheduled for completion this year.

An 80 to 100 barrel-per-day unit, this plant will gasify pulverised coal with oxygen and superheated steam and convert the resulting synthesis gas—carbon monoxide and hydrogen—to liquid fuels by the indirect Fischer-Tropsch process. Production costs are expected to approximate those of the hydrogenation process.

Four Stages

By-products of the process will include wax, alcohols, and hydrocarbon gases. Through cracking, the wax can be converted to diesel fuel and lubricants, or it may be used directly in polishes, insulating materials, and chemicals. The alcohols also are equally valuable. The new plant will consist of four distinct parts: (1) Coal gasification; (2) gas purification; (3) hydrocarbon synthesis; and (4) refining of products.

In outline, the plants coal gasification cycle involves first crushing, pulverising, and drying the coal. Then, suspended in oxygen and accompanied by superheated steam, the coal will be fed into a continuous gasifier—a refractory-lined steel shell 6½ by 9 ft. internal measurement. There conversion will taken place at more than 2000°F. The required oxygen is extracted from the air at temperatures more than 300° below zero in a Linde-Fränkl unit imported from Germany and reconditioned.

After purification, the synthesis gas is prepared for conversion to liquid fuels in two new type converters, which it is claimed, can be built to produce 500 or more barrels daily.

Massive forged steel converters at the coal hydrogenation demonstration plant built to withstand pressures of 10,300 p.s.i. Each is nearly 43 ft. high, has a diameter of 50 in. and weighs approximately 100 tons when fully assembled. The convertors are enclosed in reinforced concrete compartments to minimise risks in the event of fire or explosion

Canada's Trade Fair

Representative Chemicals & Instruments

TWENTY-NINE countries will be represented at the Canadian International Trade Fair which is to be held in Toronto from May 30 to June 10.

There will be a representative chemical section in which Canada herself will be the main exhibitor, with displays of radioactive materials for industry, research and medicine, radiograph capsules and accessory equipment for non-destructive inspection of castings and weldings. An Ionotron static eliminator will be of interest to the printing and textile trades.

Industrial chemicals to be shown include: calcium carbide, acetylene black, lime, hydrate, burnt lime, acetic acid, acetic anhydride and acetone butyl alcohol.

In the manufacturing chemical field, displays of antibiotics, fine chemicals, reagents and medicinal specialities for use in the industrial, analytical and nutritional fields will be presented.

Paints for every purpose (including phosphorescent and fluorescent types), will be exhibited, also plastics, explosives and ammunition, cements, solvents, household and farm sprays, varnishing, water-proofing compounds and other surface treatments.

Among the scientific and optical instruments, two Swiss firms are participating for the first time, showing precision instruments, speed-measuring instruments, tachometers, remote registering systems, etc.

The United States, Jugoslavia and Sweden will be exhibiting in the iron and steel and non-ferrous metals section. The last country is showing a product called Kanthal, a metallic-resistance material for use in making electrical elements for industrial and domestic appliances.

REBUILDING SCIENCE MUSEUM

WORK has now begun on the demolition of the southern galleries of the Science Museum, and it is hoped that the ground floor and basement of the new building will be completed in time to house the science and technology section of the Festival of Britain in 1951.

The old portion, now being demolished, was originally erected as a temporary structure for the International Exhibition of 1862, and continued to be used by the Science Museum for exhibition purposes until 1939. The galleries had been scheduled for destruction for some years.

The new centre block which will replace the galleries will have a planetarium on the roof. Completion of the four new floors will be continued after the 1951 exhibition.

More Beryllium Needed

U.S. Provision for Atomic Uses

THE U.S. Atomic Energy Commission has completed arrangements calling for the use of the magnesium reduction plant at Luckey, Ohio, for at least five years, for the production of beryllium metal and compounds to be used in the nation's atomic energy programme.

The Ohio facilities comprise 200 acres of land with 16 plant buildings, including a water plant, laboratory, control plant, and smelting building. During the war the plant was used to produce magnesium metal. Negotiations are in progress with the Brush Beryllium Company, Cleveland, Ohio, which formerly produced beryllium metal and compounds for the Commission in its Lorain, Ohio, plant, for the operation of the Luckey facility under contract to the Commission.

Beryllium can be used, like graphite or heavy water, as a moderator in an atomic reactor. Hitherto, the 13 known atomic piles in the United States, Canada, Great Britain and France, have used either heavy water or graphite as the control substance. The metal has not been purchased by the Commission since last August. Its previous uses in the atomic project were as a minor source of neutrons or in the manufacture of high temperature crucibles. Outside the atomic field, beryllium is used in alloy manufacture and as coating in fluorescent lighting tubes.

Because of the reported toxicity of beryllium special safeguards will be observed at the Luckey plant. The processes involved will incorporate new engineering and production methods which have been developed as a result of previous work with beryllium. The plant will require special ventilation and exhaust gas cleaning equipment, and all exhaust gases will be treated to remove contamination. Actual production operations are expected to begin in August

German Industrial Changes.—The Chemische Fabrik von Heyden A.G., which has a factory at Radebeul in the Eastern zone, has transferred its headquarters to Munich. It has another factory at Hamburg. A factory for the production of sodium bisulphite has been set up at Kelheim by the Sudchemie A.G. (Munich). Owing to dismantling of plant which took place last year and its precarious financial situation, the Carl Zeiss Company has been exempted for this year from delivering reparations products to the value of 15 million marks. The Duisburger Kupferhutte Company has concluded an agreement with the Rio Tinto Co., the Sulphur and Copper Co., of Glasgow, and Mason and Barry, Ltd., of London, for the treatment of pyrites residue.

High-Pressure Acetylene Chemistry

First U.S. Pilot Plant Open

(From Our New York Correspondent)

THE first pilot plant in the U.S.A. for the exploitation of acetylene derivatives, employing high temperatures and pressures, which not many years ago were considered to be impracticably hazardous, has been put into operation by the General Aniline & Film Corporation at Graselli, New Jersey.

It represents the first employment in the U.S.A., with considerable amplification, of the principles originally developed by the I. G. Farbenindustrie chemist, Dr. J. Walter Reppe. Patent rights were acquired some time ago and it is stated that the present process owes no royalties outside the U.S.A.

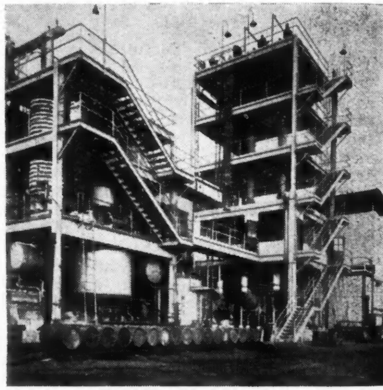
No Longer Hazardous

Dr. Carl Marvel, former president of the American Chemical Society, who was the principal speaker at a luncheon preceding inspection of the plant, said acetylene, long known to chemists for its wide versatility but little used because of its explosiveness under pressure, could now be exploited with safety as a result of the new techniques employed by the General Aniline Company. With this development, he said, a whole new field of organic synthesis was opened up which should prove of intense interest in the manufacture of resins and adhesives, pharmaceuticals, paper, rubber and textiles, to mention a few.

Remarking that the opening of the plant might well prove to be the basis in the U.S.A. for a new reservoir of chemicals hitherto unavailable, Dr. Marvel said this advance might well be compared with the introduction of high pressure hydrogenation of nitrogen to give ammonia by the Haber process, which eventually provided the chemical industry with the techniques for operating under pressures that were far above atmospheric. The introduction of the Haber process not only speeded up ammonia production, but was responsible for significant price reductions.

Potential Development

Citing other pressure reactions, Dr. Marvel said that the new acetylene chemistry was another of those novel contributions to industry. Reppe learned to handle acetylene under pressure and at high temperatures without the usual hazards. Some of the processes developed in his laboratories were actually carried through the pilot



Rear view of the plant showing fractionating stills used in isolating acetylene products

plant and into production during the war years in Germany.

Commercial firms had been reluctant to adopt high pressure acetylene chemistry and the use of catalysts, such as the very sensitive copper acetylide. It was to be expected that the introduction of these new pressure techniques with acetylene might result in a new industrial development comparable to that following the introduction of the Haber pressure technique in the 1920's.

New Products

Dr. Hans Beller, manager of the General Aniline Company's special products department, told the group that acetylene's bad reputation since its discovery in 1836, and limited practical uses in 1895, had been due to indiscriminate applications which had created a taboo on pressure acetylene. To-day, work could be carried out safely with acetylene at 200 lb. pressure and 200°C.

By making use of Reppe's discovery that acetylene could be handled under pressure and at elevated temperatures if the gas stream were divided into smaller flowing streams, it was possible to increase the use of acetylene as a chemical raw material. New products from this source that now appeared to be readily available and of considerable potential industrial use were the vinyl ethers, butynediol, propargyl

alcohol, and many others. Preliminary studies showed that from these intermediates interesting resins, adhesives, and rubber-like polymers could be made. These and other chemicals now made available by means of the Reppe technique of handling acetylene might well be the basic raw materials for another new chemical development.

German Technique

The technique permitting the safe use of acetylene under high pressures and temperatures was developed in Germany during the last war. Briefly, it consisted of two methods, one involving the dilution of acetylene with an inert gas, and the other wherein acetylene was reacted in what was essentially small-bore equipment providing a minimum of free space for gases to collect.

With a shortage of hydrocarbons, the Germans in the second world war were compelled to find new raw materials for essential war-time chemicals, especially for the production of synthetic rubber, pharmaceuticals and synthetic fibres. Derivatives of high pressure acetylene answered these needs and played a vital rôle in Germany's ability to carry on for nearly six years.

In its new pilot plant the General Aniline Company had not only widened the scope of acetylene reactions, but by the development of new processes and the installation of extensive instrumentation with remote controls, had reduced the hazard to a minimum. The specialised equipment include large and small explosion stalls or barricades, operating aisles for remote control, pressure exhaust systems and complex instrumentation generally. Reaction equipment was made to withstand tremendous overloads of pressure and was operated behind reinforced concrete walls and thick steel plates.

Currently, the work being carried on involved two processes: vinylation and ethynylation. The vinylation products included methyl, ethyl, butyl and isobutyl vinyl ethers. Another of the compounds, polyvinyl pyrrolidone, a product of both vinylation and ethynylation, was used by the Germans as a substitute for blood plasma.

While the term vinylation theoretically meant any process whereby a vinyl group $CH_2=CH—$ was introduced into a molecule, to-day vinylation was understood to mean the introduction of a vinyl group by reaction with acetylene. Acetylene was extremely reactive and added to its triple bond many reagents such as acids, alcohols and the like, at moderate temperatures and at practically atmospheric pressure.

Pressure Equipment

Dr. Reppe discovered that the addition of alcohols could be limited to one equivalent if instead of an acid catalyst an alkaline one were used at elevated temperatures. In order to carry out such a reaction with low boiling alcohols like methanol, etc., it was necessary to use pressure equipment, which meant the use of acetylene under pressure at elevated temperatures. The new technique, that of diluting acetylene with an inert gas, was worked out so that no danger of explosion would exist. That same method, with certain improvements, was now being used at the new pilot plant.

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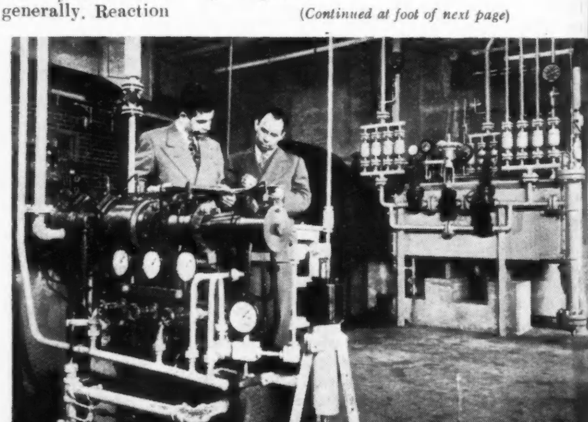


The compressor room. The special compressor (right), feeds the gas to the vinylation and ethynylation towers in the adjoining bays. The hydrogen for converting butynediol to various products is compressed by the pumps in the left foreground. Dr. Hans Beller (right) manager, and Dr. A Zoss, of the Special Products Department at the Graselli, New Jersey, plant, studying compressor charts.

India's Salt and Lignite

Active Measures to Ensure Large Production Increases

ACTIVE measures to enlarge the fuel resources of India, as well as supplies of some chemical raw materials, are reflected in current new explorations of the lignite deposits in the South Arcot area of Madras. In the Legislative Assembly of Madras, Mr. Sitarama Reddy, Minister of Industries, recalled that investigations carried out in 1943-44 revealed the existence of a bed of lignite varying in thickness from 16 to 50 feet below an overburden of about 150 feet over an area of about 25 square miles. The reserves were estimated to be about 408 million tons. The lignite found in the second layer is superior in every respect to the first layer. Samples of the former have been sent for analysis and report to the Dhanbad Research and Control Laboratory, the Tata Iron and Steel Co., and to the colleges of engineering technology. The lignite field, in the light of recent explorations, added the Minister, seems to cover a very much wider area than was realised. Extensive prospecting operations, with deep drilling machinery, are being arranged.

The Government have held discussions with Czechoslovakian, United Kingdom and United States of America delegations which visited the Province, on the question of the utilisation of the South Arcot lignite. It is proposed to obtain bulk samples of lignite and send them to foreign countries to test their suitability for use in iron and steel and other industries.

Another indication of India's policy of widening indigenous chemical sources has been referred to by the Finance Minister of the Government of West Bengal, Mr. N. R. Sarker, telling the West Bengal Assembly that a provision of Rs.200,000 had been made by the Government to develop the salt industry on the sea coast.

Three belts covering approximately 6000 acres have been selected for large and small-scale developments. They could render West Bengal self-sufficient in respect of salt.

The Government of Orissa has revealed that the Government of India is formulating comprehensive measures to step up indigenous production of salt and a licensing system for large-scale manufacture and measures to encourage production by co-operative societies will be operated shortly.

According to the Government of Orissa's plan, individuals or groups may produce salt by any means, without licence or tax.

HIGH PRESSURE ACETYLENE CHEMISTRY

(Continued from previous page)

The new reaction, vinylation of alcohols—and also of mercaptans, amines, and higher fatty acids—was relatively simple; the yields from most primary alcohols were nearly quantitative. The process ran, in general, as follows: The alcohol to be vinylated was mixed with an alkaline catalyst and heated with acetylene diluted with nitrogen under a total pressure of about 150-200 p.s.i. The product, the vinyl alkyl ether, was then degassed of excess acetylene, and rectified. The chemical reaction was written as follows:

$$H—C{\equiv}C—H + ROH——CH_2——CH——OR$$

Ethynylation referred to a reaction whereby acetylene was condensed with a reagent such as an aldehyde so that the triple bond of acetylene was preserved. Dr. Reppe discovered that by using acetylene under pressure at elevated temperatures, and employing a most unusual catalyst, copper acetylide, which ordinarily was very explosive, acetylene would react with either one or two equivalents of formaldehyde to form propargyl alcohol and butynediol. This process, requiring special safety techniques for handling the compressed acetylene, because the dilution method used successfully in the vinyl ether process was not satisfactory, ran as follows:

Dilute aqueous formaldehyde was mixed with undiluted acetylene under about 90 p.s.i. and passed at about 100° C. over a copper acetylide catalyst (containing bismuth to prevent cuprene formation). The products were then degassed, any unchanged formaldehyde and propargyl alcohol were removed by distillation, and the main product, butynediol, was obtained as a concentrated water solution, from which it could be isolated as a colourless crystalline solid.

The two-step chemical reaction was written as follows:

$$H—C{\equiv}C—H + CH_2O——H—C{\equiv}C——CH_2OH$$
(propargyl alcohol)

$$H—C{\equiv}C——CH_2OH + CH_2O——HOCH_2——C{\equiv}C——CH_2OH$$
(butynediol)

Dr. Beller told the inspection group that the high reactivity of acetylene under pressure made it perhaps the most versatile tool available to the organic chemist and that for this reason it was impossible to predict with much hope of accuracy the full extent to which acetylene derivatives might contribute to the future economy.

PROCESS CONTROL INSTRUMENTS

Correct Installation, Maintenance and Adjustment

By LEO WALTER, A.M.I.Mech.E., M.S.I.T.

AUTOMATIC control instruments must be very carefully installed and tested, before coming into continuous operation, if maximum benefit is to result from their use. A good installation will, in addition, allow testing of a controller without closing down the process.

That, for example, will permit a control valve to be inspected, cleaned and serviced, by installing it in a by-pass with isolating valves. The control mechanism will be easily accessible, so that auxiliary equipment, such as strainers, filters, air reducing valves and compressors can be serviced without undue effort.

Adjustments

Even though the installation has been perfectly installed by the supplier, difficulties are likely to arise thereafter; control may become erratic, and even hunting may develop suddenly, imposing on the plant engineer the task of improving bad control by means of re-adjustments. Such re-adjustments might also become necessary if excessive offset develops, which cannot be tolerated.

The problems confronting the works engineer are manifold. They may be comparatively simple, or complex, according to the nature of the trouble and elaborateness of the instrument design and of the controlled process.

In a well organised works the diagrams and cure of such troubles can usually be undertaken by experts. There are, however, still chemical plants whose workpeople are not sufficiently familiar with the design and function of their control instruments, or who have insufficient knowledge of the basic control theory to make re-adjustments of controllers, and the necessary correction of working conditions of the controlled plant itself. In such circumstances, the usual course is to send the instruments back to the makers, leaving the plant equipment without automatic control, at least for days, possibly for weeks or months.

Repair Service

The alternative is to call in a service engineer from the makers, if the repair can be performed locally. Manufacturers' repair departments are not usually overstaffed, and in some circumstances weeks may elapse if a major repair is required, needing recalibration and making of special spare parts. It is equally possible for a service engineer to travel hundreds of miles to find that, by blowing out a choked air nozzle within the mechanism, adjusting a spring tension, or by a simple resetting of proportional band width, the controller has been put to work again.

The best service from instrument makers is certainly no adequate substitute for an intimate knowledge by workpeople of the design and function of their instruments. Knowledge is the crux of the problem of preventative maintenance and smooth working of instrumentation, and lack of it is more pronounced in the smaller and medium-sized works, without instrument specialists. Some of the largest works have not only their own instrument department, they also design and even make specialised instruments in their own instrument shop.

Wherever instruments have been installed, even in small or medium-sized works, somebody must be responsible for their perfect functioning, and the responsibility cannot be delegated to someone else lacking the fundamental knowledge.

Job for Specialists

Such delegation, however, is not unknown, as the present writer had reason to know. In the course of a routine visit to a works employing a fair number of recorder controllers, mainly hydraulic-operated, using town gas as heating medium, the plant specialists were received by such a delegate. Because of the impossibility of explaining to him the effect of widely fluctuating gas pressure in the mains, requiring a local gas governor or individual pressure regulators, that visit was wasted. No one without equivalent qualifications can replace the works chemist or the plant engineer.

The knowledge which qualifies a man to undertake the supervision of instruments in a works cannot be gained by practice alone. Trial and error methods are too costly and theoretical knowledge is essential. Just now, many instrument courses are being arranged by various authorities, and the desirability of sending workpeople to attend them is evident. For the ambitious apprentice, the makers' workshops are a good training ground.

While knowledgeable operation and servicing are essential for the successful use of control instruments, correct installation is even more fundamental, and prolonged

and reliable functioning cannot be secured without it.

All so-called "auxiliaries" must be correctly located, so that they can be inspected and easily cleaned. Strainers, filters, pressure gauges must be accessible and regularly serviced. Accessibility of single controllers is of utmost importance because it invites maintenance. Large centralised measuring and control instrument panels naturally receive more attention than isolated controllers attached to process equipment.

Long Distance Problems

These must not be neglected in favour of panel instruments, although the latter, requiring long distance transmission, may be hard to maintain and to keep clean.

Long capillary tubings are difficult to replace in case of failure; long pressure-transmitting pipes contribute to distance-velocity lags of the system. The same applies to long connecting pipes from an orifice, which should be free from sharp bends and avoid air pockets.

Diaphragm control valves should be located near the controller mechanism; long air pipes provide more risk of leaks and increase time lags.

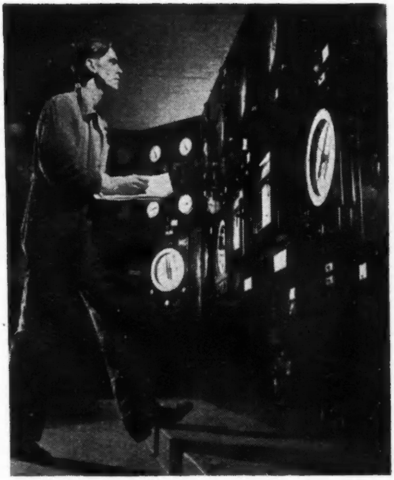
Control valves preferably should be installed vertically in a horizontal pipeline; this reduces friction of the valve stem, although it might sometimes be necessary for reasons of better accessibility to install diaphragm valves in vertical supply pipes.

The importance of the function of pipeline strainers in front of each control valve cannot be over-emphasised. This is often proved to have been fully justified when cleaning the amazing accumulations of dirt from such strainers.

Controller Adjustments

The subject of adjustments and re-adjustments bulks large in the successful operation of a newly installed controller. Control instruments, for various reasons, are not always supplied by the manufacturers correctly set, so that they have to be adjusted on the spot. Re-adjustments may, of course, become necessary later; manufacturers' instructions should make this possible. Simpler types of automatic controllers have very few means of adjustment, and the chance of encountering difficulty is proportionately reduced. For example, a self-actuated reducing valve, a self-contained temperature regulator, a thermostat switch or pressurestat switch or a float-type lever controller for liquids do not usually require a specialist to service them.

Adjustment of on/off regulators is the easiest, because, apart from correct setting of the control point, it is generally necessary only to adjust the operating differential to provide the required time periods for open, or for shut in case of reverse control action (cooling). On/off control is based solely on periods of time for admission of 100 per cent, or of none of the controlling medium. All that the user of an on/off controller can usually adjust is the operating differential of the mechanism.



[*Courtesy of Monsanto Chemicals, Ltd.*

This very advanced example of labour economy by centralised control regulates an entire manufacturing process under the supervision of one technician

Adjustment of controllers using single-speed floating control is similarly limited. The same applies to proportional controllers having a fixed proportional band (throttling range). If the switch of the band does not produce the required result, very little can be done about it, and greater offset has to be tolerated.

Proportional controllers with adjustable width of band at least give an opportunity to make adjustments, which might adapt the throttling action to some extent to process characteristics. By narrowing the control band the valve movement becomes greater per unit of change of variable—and *vice versa*.

There are, however, limitations to the narrowing of throttling range because hunting may develop. Adjustments of control band must be performed gently in small steps, and time must be given to the control instrument to settle down. Where

possible, adjustments should be extended over several hours, or even days, to give the instrument a chance to find its equilibrium.

All that is usually required to adjust the less elaborate controllers is to turn a knob, or a set screw; a scale indicates the set width in per cents of the instrument range.

Difficulties can arise where more elaborate controller types have to be installed, for example of the "stabilised" gradual types, using automatic reset or reset-rate modes. It is a fact that the greater adjustability of a controller the more chance there is for adapting its operation to process characteristics; on the other hand, adjustments must be made in the proper sequence, by the correct amounts, as required for the particular application, to produce the best controller response.

Pneumatic Controllers

A typical example is a pneumatic controller applied to an industrial process. It must be assumed that location of the detecting element (thermostat bulb, orifice for rate of flow, ball float, etc.) is correct, that controllability of the process is good, that external process characteristics are favourable. Equally, the type of diaphragm control valve must be correct, and respond to change of output pressure (air pressure in branch line) satisfactorily. The control mechanism must, of course, be perfectly clean, and all dirt, grit, and grease, etc., removed from the air supply. Air lines must be tight, strainers and filters in good working order.

It might be useful to describe the method and sequence of adjustments to be performed on a reset-rate controller, being the most difficult. Having first cut out the rate action, by reducing the rate time on the appropriate needle valve to zero, the next step is to set the reset rate at a maximum by fully opening the reset needle valve (or restriction screw, etc.). A rapidly reacting reset response results, with no rate action.

Throttling Range

The dial for throttling range is then slowly adjusted until diaphragm pressure is about 10 p.s.i. It is advisable to wait 15 minutes until the instrument has settled down before re-adjustment of the reset rate to a minimum is performed. The throttling range is then re-adjusted so that the gauge shows maximum air pressure, and output pressure from controller is adjusted to 10 p.s.i.

The control pointer might then be very close to the pen pointer. All these adjustments have been made with the control valve by-passed to leave the process undisturbed. Now the hand-controlled by-pass valve is gently closed and the isolating valve opened to permit flow through the diaphragm control valve.

Should the process-variable now oscillate, it is advisable to lower instrument sensibility by widening the proportional band. If the process remains steady, the proportional band is narrowed until a slight tendency to hunt occurs, when the band is again slightly widened. The control pointer may have to be slightly re-adjusted. Width of control band should be as narrow (sensitivity as high as possible) as is permissible with stabilisation of the variable.

The reset component can now be put into action by gently opening the needle valve admitting air to the reset bellows, or reset-mechanism in general. To find the correct position for rest, it is advisable to produce an artificial disturbance in the process, watch movements, and again to reduce the reset rate until the process becomes stable. Reset rate should be as high as possible, without causing over-shooting or hunting.

The next point for attention is the rate component, for shortening stabilising time. This can be achieved by gradually closing the needle valve leading to the reset bellows. After each small adjustment it is advisable to produce a small artificial disturbance in process. A point will be reached when stability can no longer be achieved, and heavier oscillations appear. This is the moment to reduce rate time slightly—and to leave it at that.

Fundamental Control

The foregoing helps to emphasise that performance of correct adjustments in the right sequence and intensity is a science in itself, and really requires full understanding of fundamental control theory by the man in charge of instrumentation and his staff. It is obvious that the use of very elaborate control instruments has the great advantage of providing means for a multitude of adjustments; this, however, might turn into a considerable disadvantage, where no skilled workpeople are available to perform these adjustments intelligently.

This latter point will have to be carefully considered by users and makers of instruments alike before any decision is made about the mode of control to be used.

Improved Carbonising Equipment.—Wrexham Health Committee was informed last week that a letter from the gas company discussing atmospheric pollution said that mechanical stokers were to be provided later this year at Wrexham gas works and that a new modern carbonising plant to be installed was expected to be working early in 1952.

ELECTROMETRIC METHODS OF ANALYSIS—I

The Polarograph

From a Special Correspondent

APART from electrodeposition methods in analytical chemistry, there are two important branches which have in the past few years become almost indispensable—the broad field of electrometric titrations, and the technique of polarography.

Although, strictly speaking, the interest of the analyst in the latter branch is the later development, it is convenient to discuss the polarograph before proceeding to a consideration of the wider field. Electrometric titrations nowadays are normally held to include, together with the well-established conductometric and potentiometric titrations, the new procedure of amperometric titration.

The last, a logical development of polarography, has developed more recently, and for its understanding an acquaintance with the theory of the polarograph is essential. This excuses departure from the chronological sequence.

Work of Heyrovsky

The polarograph, which is roughly synonymous with the "dropping mercury cathode," was first brought to the notice of chemists by Heyrovsky in 1922. The work of his school had by the early 1930's developed to such a stage that the instrument was in danger of being over-rated, and it was applied to many unsuitable uses in addition to the undoubtedly valuable purposes which popularised it. Still later there was a tendency for the pendulum to swing in the other direction, so that in some quarters it was neglected even where its use would have been legitimate.

It is probably safe to say that nowadays a truer appreciation of its place in the armoury of the analytical chemist has been reached, and there is less tendency to strain after analytical methods that make the instrument the important factor, and the analytical results of secondary consideration. In fairness it must be said that practically every instrumental method of analysis has gone through a somewhat similar cycle; in the case of the polarograph the extremes were more in evidence.

Broadly speaking, the polarograph has a close affinity with electrodeposition, since it is from the study of phenomena which take place on electrolysis that analytical results are obtained. However, the method is applied in conditions which differ very widely indeed from those which obtain when electrodeposition is applied to direct gravimetric analysis.

In the latter, an electrode is used in circumstances which try, as far as possible, to eliminate polarisation. In the polarograph, the phenomena studied are those which take place at an electrode which is chosen specially on account of its ready polarisation.

Minimum of Decomposition

In electrochemical deposition the analyst is concerned with obtaining a large deposit, which can be accurately weighed. In the polarograph, the minimum of decomposition takes place.

In electrodeposition, the reaction which most often takes place,

$$M^{+} \rightarrow M$$

where M represents a metal, is, of course, when regarded in the broadest sense a form of reduction reaction. But the analyst is not normally particularly interested in this apart from the complications which may take place in the presence of oxidising agents or reducing agents and which may prevent or modify this reaction.

When dealing with the polarograph, however, the analyst is primarily conscious that the essential reaction is a reduction one (or, more rarely, an oxidation) and is also conscious that this may take place in several stages, all of which will have their effect on his interpretation of his results, as, for example:

$$M^{++} \rightarrow M^{+} \rightarrow M$$

Finally, while in electrochemical deposition the determination may be said to be direct, in that metal is usually weighed as such, in polarography the determination is in all cases indirect, and, indeed, in most cases is also relative, since it is not usual for the analyst to obtain his result by calculation from first principles. He more usually obtains it by reference to a series of determinations on known solutions under identical conditions, or by use of an internal standard.

Electron Transfer

It will be clear, therefore, that although the affinity to electrochemical deposition is a logical starting point, it has little bearing on a discussion of the instrument from the point of view of analytical investigations.

As has been stated already, oxidation and reduction can be directly related to the phenomena which takes place at an electrode when a substance is being deposited. In both cases an electron transfer is involved, so that the process

$$M^+ + e \rightarrow M$$

is a reduction process, while the reverse

$$M \rightarrow M^+ + e \text{ or } A^- \rightarrow A + e$$

are strictly speaking oxidation (A^- representing, for example, an anion).

At the cathode reduction processes are expected to take place, while at the anode oxidation is the rule. Although the processes of polarography could be applied equally well to either electrode, it is historically true to say that by far the greatest bulk of investigation has been of cathode processes, and this article will confine itself primarily to these. It should be borne in mind, however, when apparatus is being discussed, that the argument would apply equally well, *mutatis mutandis*, to anode processes.

Basic Apparatus

The usual polarograph electrolysis cell (Fig. 1) consists of a small cathode, C, which will readily undergo concentration polarisation, and which is usually provided by a small drop of mercury issuing from an extremely fine capillary; and a large non-polarising anode, A, which is in most instances provided by a pool of mercury at the bottom of the electrode vessel.

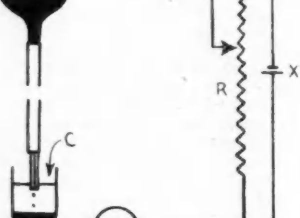


Fig. 1

Some means of controlling the rate at which the mercury flows from the capillary is usually provided, since this rate of flow should be highly reproducible.

The fact that the mercury is flowing constantly in the form of small drops provides that there will always be a clean, easily reproducible, and readily controlled cathode surface.

Voltage is supplied from an accumulator, X. It can be increased progressively from zero by use of a potentiometer, R. Some means of relating current to the voltage tapped off by the potentiometer is provided, and (in Fig. 1) his is indicated in its simplest form by the inclusion of a volmeter, V, and a sensitive galvanometer, G. The various ways in which this may be achieved practically in more elaborate set-ups will be considered later.

It is now necessary to consider briefly the relation of current to voltage in a cell such as that described, since on this depends the results obtained for interpretation by the analyst. In practice, as the applied potential is increased progressively from zero, there will be a small, and, at first, almost inappreciable passage of current, which is usually referred to as the *diffusion current*. This is represented in Fig. 2 by the portion of the curve OA.

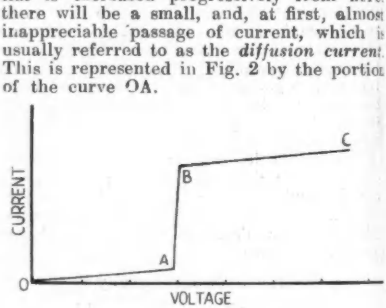


Fig. 2
Theoretical current-voltage curve

None of the ordinary electrolytic phenomena will at first appear, and the electrolyte, perhaps a simple one such as copper sulphate, will not be deposited. When, however, the decomposition potential of the electrolyte is reached, electrolysis proper begins, and there will be a rapid increase in current with very little increase in voltage (AB in Fig. 2).

This arises from the fact that at the decomposition potential the voltage is powerful enough to transfer electrons. Reduction of the copper ions begins, and, consequently, with the transfer of electrons, current passes.

A State of Equilibrium

There is, however, a limit to the amount of this increase in the diffusion current, because of the ease of polarisation of the electrode. Since the cathode is small, the rapidly increasing current will soon reach a point which corresponds to a state where all the ions in contact with the cathode at one time are immediately reduced.

Thus a state of equilibrium results, and further increase of voltage cannot result in any marked increase or reduction, of passage

of electrons, or of increase of current. An inflexion point, B, therefore is found when the complete curve is plotted (OABC in Fig. 2).

In actual practice, the current as plotted has not the sharp angles shown in Fig. 2, and is more like that of Fig. 3, the angles being rounded to a greater or less extent depending on experimental conditions. But this does not prevent the worker from arriving at the theoretical curve, since the straight portions of the curve may be extrapolated, as shown by the dotted lines, to give an approximation at least to the theoretical.

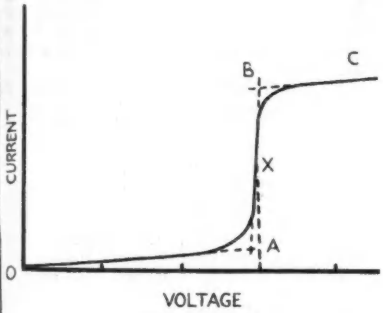


Fig. 3

The decomposition potential of the ion in the electrolyte is usually taken as the voltage corresponding to the point *X*, half-way along the current-voltage "wave," as it is usually termed. In most determinations where it is necessary to have a precise value for this, it is related in volts to the value for a standard calomel electrode as zero. This voltage is usually termed, in polarographic work, the half-wave potential.

Analytical Data from the Wave

Under standard conditions of temperature, and using standard electrodes, the half-wave potential for any ion is characteristic of that ion. Therefore if a numerical value is obtained for the half-wave potential, this will indicate qualitatively the ion being reduced.

It should, of course, be borne in mind that one ion may give rise to several half-wave potentials, corresponding to the different stages in its reduction, as, for example:

$$Fe^{+++} \rightarrow Fe^{++}$$
$$Fe^{++} \rightarrow Fe.$$

It has been pointed out earlier that when equilibrium was attained among the ions immediately adjacent to the cathode, the rapid increase of current ceased. The number of ions is obviously directly related to the concentration of these ions throughout the solution as a whole. The greater the concentration, the greater is the number of ions immediately adjacent to the cathode, and the greater increase in current before all are in equilibrium.

As a consequence, it is clear that the height of the current-voltage wave is directly related to the concentration of the ion being reduced. We are thus in the happy position of being able to deduce that when, in a polarographic experiment, a current-voltage wave is produced, the half-wave potential is a qualitative indication of the nature of the ion, while the wave-height is a measure of the amount of the ion in the solution.

Applying these considerations to a solution containing several ions, we find that in simple cases at least the results are a logical extension of those discussed so far. Thus, in a solution containing 10^{-4} g./ions per litre of copper, cadmium and zinc, a curve such as that shown in Fig. 4 would be obtained. The steps corresponding to the three ions are clearly seen, and they are all approximately the same height.

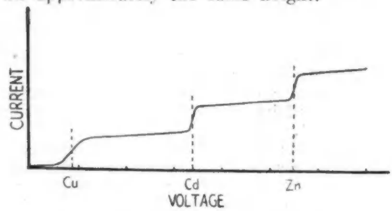


Fig. 4
Solution containing 1×10^{-4} g. ion each of Cu^{++}, Cd^{++} and Zn^{++}

If, now, the amount of copper is doubled, and the amount of zinc is trebled, while the amount of cadmium remains the same, the curve will have altered to the form shown in Fig. 5.

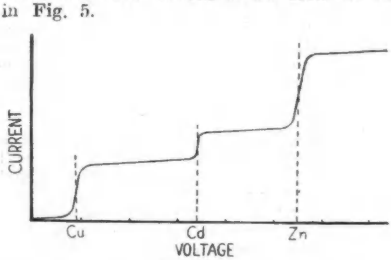


Fig. 5
Solution oontaining 2×10^{-4} g. ion of Cu^{++}, 1×10^{-4} g. ion of Cd^{++}, and 3×10^{-4} g. ion of Zn^{++}

It will be seen by comparison that the half-wave potentials have remained the same, but that the wave-heights have altered to accord with the new proportions of the ions.

In general, then, we may take it that in the current-voltage curve of a complex electrolyte the following phenomena will be observed:

The preliminary portion of the curve represents the period during which no decomposition takes place.

Concentration of the Ion

When the decomposition potential of the most easily reducible ion is reached, the curve rises to produce equilibrium between the cathode and this ion, and reaches a height which is related to the concentration of the ion.

This is followed by a second period of little increase in the current, until the decomposition potential of the second reducible ion is reached.

A further period of rapid increase ensues, Equalibrium is once more reached, and the process is repeated till no more reducible ions remain in the solution and the final equilibrium continues.

If, now, the current is sufficiently increased, the solvent itself will begin to decompose, and any subsequent increase in voltage will be followed by a large increase in current.

This is an extremely simplified treatment of the process and a few complications must be mentioned. When an actual experiment on the lines of the simple electrolysis described above is carried out, the current observed will be larger than that suggested by the simplified treatment, because it is made up, not only of the diffusion current which is directly related to the concentration of the ions in solution, but also of what is known as a migration current.

The Migration Current

This last is due to the migration of the ions in the electric field, and has no direct relation to concentration of the ion. The relation between the total current, I_t and the two components may be expressed

$$I_t = I_d + I_m$$

If the migration current can be suppressed, it is clear that total current will approach the diffusion current proper, and will be directly related to the concentration. It was essentially Heyrovsky's discovery of a way to achieve this that made the development of the polarograph possible.

Heyrovsky found that if a relatively large quantity of an otherwise inert electrolyte, such as potassium chloride, or potassium nitrate, was added to the solution, the total current decreased to a constant value which was related to the concentration of the reducible ion, and which was obviously closely approximating to the diffusion current alone.

The practice is therefore followed in all polarographic experiments of having present a high concentration (of the order of Normal) of such an electrolyte.

Since the half-wave potential of potassium is considerably greater than those of ions normally determined polarographically, there is no detrimental effect from this and it can be shown theoretically that such a practice does in fact cause the total current to tend towards the limit of the diffusion current. Such an electrolyte, added for this purpose, is usually referred to as the supporting electrolyte, or the base electrolyte.

A second complication arises from the fact that oxygen is reduced at the dropping mercury cathode at two potentials corresponding to the reactions.

$$O_2 \rightarrow H_2O_2$$
$$\text{and } H_2O_2 \rightarrow H_2O.$$

If it desired to carry out determinations requiring the use of regions at which these processes take place, it is necessary to remove dissolved oxygen from the solution by the passage of an inert gas, such as nitrogen.

Half-Wave Potentials

Thirdly, the voltage range usually covered, which is restricted by the breakdown of the solvent or the base electrolyte, is in the range of +0.6 to −2.6 volts against calomel. If, then, we are concerned with a possible range of 50 cations, and if these were ideally arranged so that they were equally spaced throughout the whole possible range, then there would be only an average separation between the half-wave potentials of 0.06 volt.

But it is generally admitted that to distinguish clearly between two reducible ions, at least 0.1 volt, and in special cases more, must separate the half-wave potentials. Therefore certain combinations of ions will not be determinable directly. Indeed, the position is rather worse than this ideal situation, since the half-wave potentials are, of course, not thus conveniently arranged at regular intervals throughout the range.

This drawback can be overcome in certain cases by the device of complex formation. For example, the half-wave potentials of cobalt and nickel are too close to allow them to be determined directly in a single solution. But the addition of pyridine forms complexes which are readily separable by the polarograph. In many cases, however, the only procedure so far satis-

factory is a preliminary separation of interfering ions.

Yet another disadvantage is that the curve actually obtained in a determination may be different from the theoretical one because of an initial unexplained peak which may be so large as to swamp the current-voltage wave completely (Fig. 6). This can be suppressed wholly or in part by the addition of certain colloidal materials, such as starch, but it may nevertheless be the cause of considerable trouble.

For even a brief consideration of the practical aspects of polarography, we must examine the types of apparatus which are used, and the experimental precautions which must be observed.

In the first instance, successive readings on a sensitive galvanometer may be made, and these are subsequently plotted against the voltage. For convenience, the potentiometer is usually adjusted so that its complete throw corresponds to an integral value of volts, such as 2, or 3.

It should be possible to read the potentiometer in small steps, and some means of checking it from time to time should be available. The galvanometer may either be of the mirror type or pointer type, but it should be provided with a shunt or shunts, since large ranges of currents may be met with.

Flow and Temperature

The cell should be provided, as already mentioned, with a means of controlling the mercury flow precisely, and with some form of temperature control. This can be seen from consideration of the important Ilkovic equation which is expressed,

$I_d = 0.63n.F.C.D.^{\frac{1}{2}}\ m.^{\frac{2}{3}}\ t.^{\frac{1}{6}}$

where n = gain in number of electrons (in general, valency of ion)
F = 96,500 coulombs (Faraday)
C = concentration of ion
D = diffusion coefficient of ion
m = mass of drop of mercury
t = time of formation of drop of mercury
I_d = diffusion current

It is evident that the mercury dropping rate is of importance here. But it must be borne in mind that every factor in this equation except *n*, and including even the numerical factor, is dependent on temperature, to such an extent that precision of ±1 per cent in the determination of I_d requires temperature control to at least ±0.5°C.

Since a determination, using manual alteration of the potentiometer, and repeated readings of current and voltage, is laborious, various types of apparatus have been proposed which will provide an automatic technique.

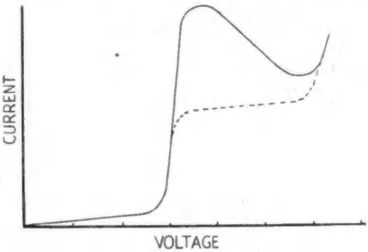


Fig. 6

Peak (full line) and suppression of peak (broken line)

By permitting a beam of light from the mirror galvanometer to fall on a rotating drum, geared to the potentiometer, and carrying a strip of photographic paper, it is possible to get a complete trace of the polarogram on developing the paper. This has the advantage of speed, removal of personal error in reading, and permanence of record.

In addition, it is possible to repeat a trace a second time on the paper, to indicate reproducibility or otherwise of results. The usual practice is also to superimpose on the paper a standard grid which indicates the voltage and current units.

Some workers held that the photographic methods had several serious drawbacks. In the first place, one might only be interested in a small portion of the curve, but it was necessary to take the photograph of the complete range. In the second place, results had to await processing of the paper. Thirdly, the paper was concealed (since it was light sensitive) during the course of the determination, so that it was impossible to observe the curve while it was being made, which might in some instances be desirable.

Pen-Recording

As an alternative, pen-recording was introduced. The only principle variation here is that the galvanometer operates a sensitive pen, which traces the polarogram, and the drum is, as before, geared to the potentiometer.

Discussion of the theoretical aspects of the instrument will have made it clear that the polarograph is not, in general, applicable to unknown materials, although in its earlier development enthusiasts were apt to represent it as the ideal automatic analytical machine.

It forms, however, an increasingly useful analytical instrument in dealing with systems whose current-voltage characteristics have been thoroughly studied. It can be used for many cases of routine analysis,

and has the advantage that the result is obtained in a very short space of time—of the order of half an hour or less, while in any of the recording types of instrument, the results may be stored for reference.

For the measurement of small quantities of material the instrument has a number of advantages. As little as 0.1 ml. of solution may be used in specially designed cells, and as the solutions are usually very dilute, the absolute amount of material determined is often very small indeed.

Trace Elements

It is clear, then, that one of the major fields of application has been in the determination of trace elements. Often ingenious methods of separation or concentration of extremely small amounts of trace elements can be applied first, so as to bring the total material estimated within the range of the instrument.

Typical applications which may be mentioned are the determination of zinc in copper-base alloys and in aluminium alloys, and many other metallurgical analyses, the determination of tin in foodstuffs, and of copper and cadmium in biological materials.

Although their development is more recent, applications to organic determinations are becoming quite common following many fundamental investigations of organic systems. Direct reduction of organic substances is not often carried out, since the curves obtained may be so complex, due to such factors as several-stage reductions, as to be useless for analytical purposes. Polarographic study of carcinogenic substances, and of sex-hormones, has proved to be of considerable help in analytical processes, but is by no means straightforward.

But many ingenious indirect analyses, which depend on a final polarographic determination of an inorganic material, have been worked out.

Inorganic Ions

Curiously enough, a few instances occur of the use of an organic substance for the determination of an inorganic ion—the reverse of the normal state of affairs.

For example, calcium does not give a very satisfactory polarographic wave, while picrolonic acid is readily determined by the method. So that if a known excess of a picrolonic acid solution is added to a calcium solution, precipitating the calcium picrolonate, the excess of the picrolonic acid can subsequently be determined, and it is noteworthy that it is not even necessary to remove the precipitate before polarographing.

Finally, the abnormal peak, mentioned earlier, which is suppressed by addition of colloids such as albumin, may be used for the determination of the substances which act as suppressors.

The concentration of suppressor necessary to reduce the peak to half its size is determined, and the actual suppression by the unknown is then related to this. A number of dyestuffs, in addition to the colloidal materials with which this is usually associated, have been determined by this method.

As a final note, it should, perhaps, be pointed out that although the obvious applications of the polarograph is to the determination of trace amounts, there is no reason why it should not be applied to larger quantities, and this has, of course, been done in many well-established analyses.

Paper Pulps from Straw

New Mechano-Chemical Process

SIGNIFICANT advantages in accelerating processing by violent agitation are claimed for a new method of making paper pulps from wheat straw, known as the "mechano-chemical" process, which was recently announced by Dr. G. E. Hilbert, chief of the U.S. Department of Agriculture's Bureau of Agricultural and Industrial Chemistry.

The new method, developed by doctors S. I. Aronovsky and E. C. Lathrop in the bureau's Northern Regional Research Laboratory, Peoria, Illinois, eliminates the need for pressure and drastically reduces the cooking time required. Instead of cooking under high pressure for several hours, it was found that with more effective chemicals and mechanical stirring larger yields of high-quality pulp were obtained after cooking the straw at atmospheric pressure for only half an hour.

Tests of the mechano-chemical process in commercial operations are to be undertaken shortly. Pilot plant studies at the laboratory showed that it produces a pulp that bleaches easily and is suitable for blending with other pulps to make high-grade papers. Equipment requires less space, labour and power, and is expected to lower costs.

Ductile Piping.—A new type of piping, "Kuterlon" copper made by I.C.I. Metals Division, will be used this year for laying on the supply of water for the Bath and West Agricultural Show to be held in Bristol. This ductile piping will be laid by a "mole" plough which drives through the ground with minimum disturbance to the surface.

Radiation Detection

New Portable Equipment

SUBSTANTIAL advance in the field of electric and electronic metering apparatus has been made by the General Electric Co., Ltd., some of which has been produced in anticipation of widened use in science and industry of radioactive materials.

One noteworthy item in this category is a portable ionisation radiation meter produced on behalf of Watson & Sons (Electromedical) Ltd., London.

This was designed for rapid surveying of installations producing ionising radiations in order to assess the need for providing suitable protection and for the relative assaying of radioactive isotypes.

It uses a standard G.E.C. Geiger-Muller tube, and provides facilities for detecting radiation and measuring its intensity.

Headphones give an aural indication of the presence of radiation, and, simultaneously, a moving-coil meter gives a measure of the intensity, covering from 30-75,000 counts per minute in four ranges. The instrument, including dry batteries for portable operation, measures 9 in. by 6 in. by 3½ in., and weighs only 7 lb. A mains-operated power supply unit may be used for laboratory operation.

Another multi-purpose instrument by G.E.C. is a photoelectric photometer, colorimeter and spectral band apparatus, which was an evolved form of the instrument shown at the I.E.S. Convention in 1946. This is suitable for application as a monochrometer and spectro-photometer; as a photometer for measuring intensity and luminous output; as a trichromate colorimeter; and as a spectral band apparatus.

Rocket Studies

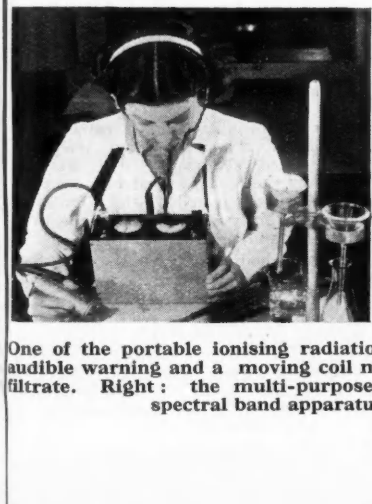
New Vacuum-Ultraviolet Emulsion

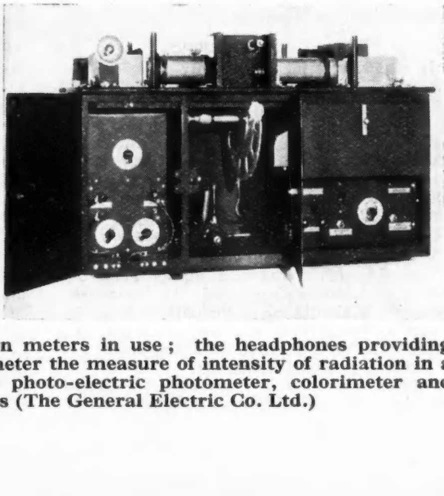
A NEW material, called a vacuum ultraviolet, or VU, photographic emulsion, developed for identifying atoms or chemicals by analysis of their radiant energies, may be employed for study of the sun from rockets, it is thought by Mr. Arthur L. Schoen and Mr. Edwin S. Hodge, of Kodak Research Laboratories, who described the material at a meeting of the Optical Society of America in New York recently. It may be used in the thin atmosphere 250 miles or more above the earth, or in near-vacuum on the ground. It is sensitive to light far into the ultraviolet.

The emulsion has extremely close-packed silver grains, with very little gelatin, states a report in *Chemical and Engineering News* (U.S.A.) *14*, 1008. The gelatin of a normal photo emulsion absorbs ultraviolet light. The new emulsion, with little gelatin, enables the ultraviolet light to be recorded.

Ultraviolet rays of the sun are intense at high altitudes where the VU emulsion may be used. While the sun's rays in this form cannot penetrate the atmospheres, study of them is important because they cause electrical disturbances in the upper air which affect weather and radio communications.

Extensive tests of the VU emulsion were made at the Kodak laboratories. Air was pumped out of a torpedo-shaped device known as a vacuum spectograph. The emulsion, in the vacuum, was exposed to a high intensity spark rich in ultraviolet radiation. The tests on the ground simulated conditions the emulsion encounters at high altitude.





One of the portable ionising radiation meters in use; the headphones providing audible warning and a moving coil meter the measure of intensity of radiation in a filtrate. Right: the multi-purpose photo-electric photometer, colorimeter and spectral band apparatus (The General Electric Co. Ltd.)

Some Developments in Industrial Viscometry

by L. A. STEINER

INDUSTRIAL viscometry has advanced in the past few years in several directions due to the fact that the demand for better products is, in general, more pronounced than in the past. Matèrials which were known to be amenable to viscometric inspection (such as mineral oils, bituminous materials, paint) are now being controlled on an increasing scale by viscometric methods in order to ensure a reasonable uniformity of deliveries.

Control of Production

With these materials past experience has shown that a certain grade is satisfactory for a certain application and viscosity was then measured with the view of forming the basis of control of production. On the other hand, materials which were developed of late (such as synthetic resins, waxes, fibres, polymers and others) are, of necessity, compared with the ones already on the market, and the knowledge of viscosity is again a valuable guide for the assessment of possible applications.

In comparison with chemical methods, the viscometric method has the advantage of leaving the material in its original state, and that the liquid tested, or most of it, is still available for other tests.

In any case, for many industrial materials a very small variation in the chemical composition may cause a very large variation in viscosity, and experience has shown that where viscosity is significant, the most efficient method of analysis is the direct measurement of viscosity.

Speed and Efficiency

If viscosity is measured only occasionally, the time spent on its determination is of secondary importance. But where viscosity is a means of control of production, the time taken for the sample to be removed, tested and approved is an important economic factor. The reduction of time spent on supervision of production is a definite means of increasing output and efficiency of both plant and personnel.

Viscometers for production control should be capable of giving reasonably accurate results with reasonable speed. The measurement itself should be sufficiently simple in order to be carried out by comparatively unskilled people without incurring breakage or damage to the instruments.

Viscosity has such a wide field of application that no single instrument can hope to be applicable to all purposes and the actual choice of the most efficient instrument will invariably depend on the conditions prevailing in the plant. Four types commercially available are discussed here in order to facilitate selection.

A comparison of the properties of various capillary viscometers was made some time ago.[1] One of the draw-backs of the BSI type of U-tube is that the volume of liquid needs accurate adjustment. The suspended level type overcomes that difficulty, but the instrument is very fragile due to the fact that three limbs are necessary instead of two, although cementing into suitable fittings will greatly increase their mechanical strength.

Of course, the benefit of a cemented metal fitting applies equally well to all glass viscometers and the use of self-aligning collars, suitably bonded to the glass limbs is becoming popular. The more so, because by careful study of dimensional specifications the author succeeded in reducing the large number of fittings to two which cover between themselves practically all types of capillary viscometers used in this country, the U.S.A. and on the Continent.

Kinematic Viscometer

It is hoped to describe on another occasion a kinematic viscometer of novel design which has interchangeable viscometer tubes, is suitable both for transparent and opaque liquids and covers a viscosity range from 0.5 centistokes to about 500 stokes.

The Steiner falling body viscometer (Fig. 1) is an instrument fitted with a strictly cylindrical measuring tube in which an accurately guided body falls a certain distance, usully 10 cm. The instrument needs less than 6 ml. to fill, is easy to clean and to handle. It has its own jacket which can be heated electrically and can be controlled by rheostat if a moderate accuracy is sufficient or connected to the circulating system of a Steiner viscosity bath type BCN if both speed and accuracy are required.

A series of bodies of various dimensions will cover a very wide range in a single instrument. Figs. 2a and 2b show the principle and in making a reading with the cylinder the time is measured for the edge of the body to pass two marks engraved on the measuring tube. The time multiplied by a factor taken from the calibration certificate supplied with each instrument, gives

the absolute (dynamic) viscosity in centipoises.

In Fig. 2b spherical bodies are the active element, *i.e.*, balls rolling down a slanted tube. Again, the time for the sphere to roll between two marks is recorded and the time multiplied by a factor gives the absolute viscosity in centipoises, as before. In order to cover a wide range of viscosity a number of spheres are supplied with each instrument.

Four falling bodies will cover a viscosity range from 10 to 100,000 centipoises, roughly corresponding to liquid paraffin and golden syrup respectively.

Fig. 1 shows stand and jacket of the latest design, a further development of the instrument described previously[2]. The jacket, as illustrated, is in the measuring position, *i.e.*, with the centre vertical. The jacket swings round a hollow spindle and rests before measurement on the top support. Handles are provided to bring the instrument into measuring position.

After each measurement the jacket is returned to reversed position and, after a short pause, the falling body is ready for the next measurement. By continuous reversal, a large number of measurements can be carried out in a short time at

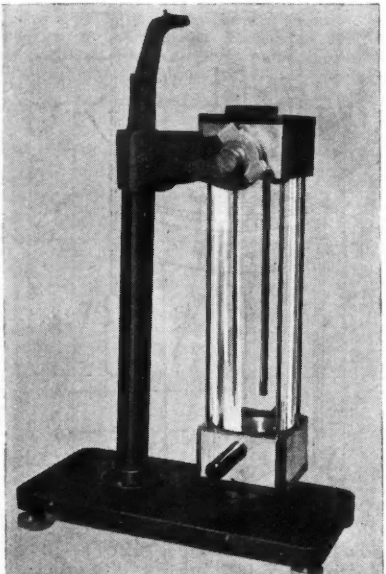


Fig. 1

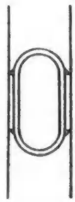


Fig. 2a

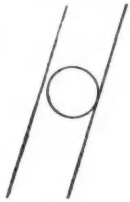


Fig. 2b

various temperatures. Any slope of the bench on which the instrument rests can be corrected by levelling screws.

The instrument is particularly suited for plotting viscosity-temperature curves and it is obvious that a viscosity temperature curve is far more informative and reliable than a measurement at a single temperature (Fig. 3).

The technique of measurement is quite different from the technique of, say, capillary viscometers and the advantages of the falling body types would be lost if handled in the same manner as is usual with capillary viscometers.

Capillary viscometers are as a rule intended for measurement at a fixed temperature, having regard to the fact that the efflux times are long and for good

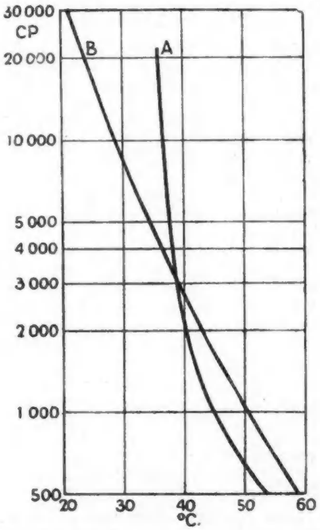


Fig. 3

reproducibility the bath surrounding the viscometer should be kept at constant temperature all the time.

In the falling body types the measuring times are short and the quantity of liquid so small that it will follow rapidly the temperature of the jacket. By observing the change in viscosity as the temperature of the jacket changes, a reliable measurement can be obtained without elaborate equipment for maintaining constant temperatures. In the average, the time taken for a viscosity-temperature curve from say 150° F. to 80° F. is 20 minutes, and correspondingly less if a smaller temperature range is sufficient.

The significance of viscosity temperature curves was discussed at length in a previous issue of this journal.[3]

In the instrument shown in Fig. 1 provision is made for measurements at a definite temperature. Water or any other suitable liquid can be circulated through the jacket and a slotted distribution tube will evenly distribute the circulating liquid.

Although a single instrument can be built which has a wide viscosity range and is applicable to a large number of materials, experience has shown that great improvements in handling and reproducibility are possible if the particular properties of certain difficult materials are met, and in the course of development several special types were evolved.

Plunger Rheometer

Industrially important liquids comprised in a large group are non-Newtonian. Appearances would suggest that some suspensions and emulsions are very viscous or even solid, but as soon as they are submitted to some form of mechanical agitation (stirring, shaking, pumping) they flow amazingly fast.

Practically all liquids of high viscosity are anomalous to some extent, *i.e.*, the rules of truly viscous flow are not uniformly applicable. In addition to pure viscosity, some liquids (for instance highly viscous rubber solutions) are markedly elastic and the viscosity figures as derived from normal viscometers are no longer representative of one property but of a mixture of several properties.

The viscosity of anomalous materials, if determined in normal viscometers, is often described as "apparent viscosity." Great objections could be advanced against the use of such a term, by virtue of the fact that "apparent viscosity" is not really a physical term at all.

A more correct characterisation of an anomalous liquid is by reference to the shear stress at which the test is carried out and to measure at as many shear stresses as possible.

For true liquids the shear stress necessary to cause a certain flow is directly proportional to the absolute viscosity, while for anomalous materials linearity is replaced by a more or less complicated curve.

An instrument which enables such a curve to be plotted easily is schematically depicted in Fig. 4. The author is indebted to E. G. Ellis for the suggestion which resulted in the present form. The instrument was modelled on the Gardner Mobilometer,[4] well known in paint industry, in which a perforated disc is caused to sink under a certain weight in a container filled with the liquid under test. A modification, the SOD instrument, replaces the disc by a cone and has been used for the measurement of consistency of lubricating greases.

The evaluation of the measurement in terms of rate of shear and shear stress is very difficult, both with the disc and the cone type instrument. A cylindrical body can be more easily treated mathematically than a disc or a cone and that was the chief reason for the choice of a cylindrical plunger (Fig. 4).

The instrument consists of a cylinder (5) filled with the material to be tested and of the plunger (4), which descends under the

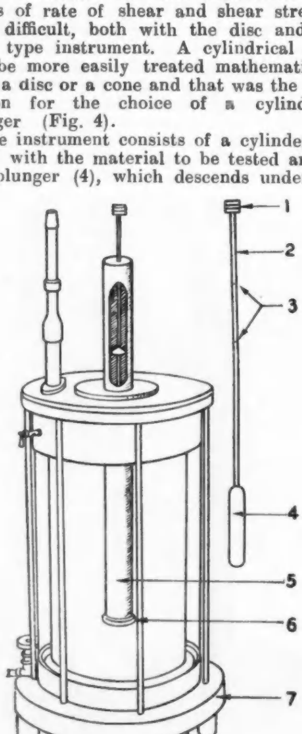


Fig. 4

load of weights (1). A set of six weights is used with each instrument. The time of fall is observed for the graduations (3) to pass a given position on the body of the instrument.

The container (5) is normally closed by a screwed cap (6) which can be taken off for cleaning and filling. The instrument can be charged either from the top, if the liquid is fairly fluid, or by pushing the cylinder into the material if it is semi-solid.

Two plungers of various size cover conveniently the range from 10 to 1000 poises, the actual range of the plungers is from 1 to 10,000 poises. The basic instrument (type RCL) is suitable for soft lubricating greases, printing ink, paint, some foodstuffs, adhesives and the like. Special plungers were already made to suit a variety of other materials such as drilling mud, ice cream and toffee.

Every instrument is individually calibrated for readings in poises, to be used with Newtonian liquids and factors are given for the evaluation of shear stress and rate of shear if used for anomalous liquids.

Type RCL rheometer is so constructed that it can be used without any special fittings in a Steiner viscometer bath (BCN, size 10), the capacity of which is six rheometers, four of which are always in front of the operator.

The type of curves which are acquired by the use of the plunger rheometer can be seen in Fig. 5 in which the value 1000/T is plotted against the net weight in grammes

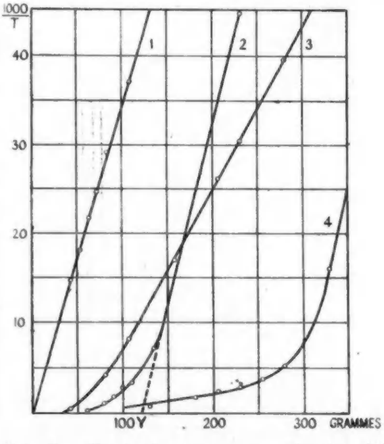


Fig. 5.—Typical curves acquired with the plunger rheometer. Curve 1, Newtonian liquid; curves 2, 3 and 4, Bingham bodies. Yield value of 3 at Y

acting on the plunger, T being the time taken for the plunger to drop between the two graduation marks on the stem.

A truly viscous material has a straight line, *e.g.*, line 1, while anomalous behaviour is divulged by the curvature of the plot.

The three curves belong to a type of hydrocarbon gel, made at three different factories of the same concern. The very great difference in the flow properties can be seen at a glance.

Momentary Similarity

Of particular interest are curves 2 and 3 They cross at a shear stress of about 170 grammes. Both materials have at this point the same apparent viscosity but below and above this point the apparent viscosity is very different. At 100 grammes sample 2 has more than twice the apparent viscosity of sample 3, while at 240 grammes sample 2 would flow much quicker than sample 3.

Curves 2 and 3 demonstrate the necessity of measuring anomalous materials at as many shear stresses as possible and illustrate the misleading nature of the term "apparent viscosity."

The curves in Fig. 5 are similar to those from which Bingham deducted the term "yielded value." If the straight line portion of any of the curves 2, 3 and 4 is extended, it will strike the stress axis at a certain point.

According to Bingham this is the minimum stress which is needed to cause flow, hence the term "yield value": in this instance $Y = 121$ grammes. That value multiplied by the instrument factor for shear stress $= 14.2$ dynes/qr. cm^2 gives the absolute yield value, in this instance 1720 dynes/cm^2.

In order to characterise an anomalous material at least 2 parameters are required, the yield value and the slope of the extended curve. The latter is interpreted differently by various authors and some times described as "plastic viscosity."

Automatic Viscometer

In a fast manufacturing process the periodic removal of a sample and its testing in the laboratory may take too long and the necessity arises to measure viscosity as part of the process, more or less in the same manner as one would measure temperature or pressure.

An instrument which indicates viscosity continuously, *i.e.*, in which the momentary viscosity of the liquid is indicated on a graduated scale is shown in Figs. 6 and 7.

The instrument is based on the fact that there will be a viscous drag between two suitably shaped bodies, one of which is rotated and the other prevented from rotation.

The drag so produced is transferred to the indicator by a thin flexible thread which can be seen in Fig. 6 on the left. The liquid enters on the top left opening which can be connected by standard union nuts to a pipe-line which feeds the viscometer with fresh liquid. The outlet is in the front part of the housing.

The viscosity range of the instrument shown in Figs. 6 and 7, is normally from 10 to 1000 poises; an extension of the range towards the lower viscosities is possible, in which instance the range is from 1 to 100 poises.

The application of rotating bodies is by no means new and their theory is well established. Departures from the theoretical requirements may easily make the readings a complex function of viscosity or entirely arbitrary.

It is obvious that the shape and dimensions of the rotating bodies must be such that there is linearity between viscosity and the indication and an experimental study with various bodies resulted in a linearity well within ± 0.5 scale divisions. Each instrument is carefully calibrated and the accuracy of calibration is ± 0.5 divisions. With 100 divisions on the scale (each about 1/16 in. apart), the accuracy of the instrument is better than ± 2 per cent.

The general arrangement of the essential parts can be seen in Fig. 7, in which (1) represents the adjuster of zero position, (2) the handwheel to actuate the adjuster, (3) the protecting tube of the scale (4) a thermometer (5) the nut which clamps the thermometer into a socket shown by (6).

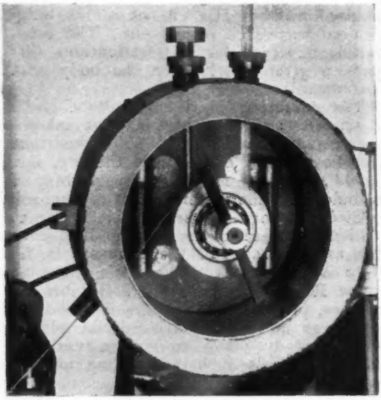


Fig. 6

(7) is the door of the housing surrounding the viscometer, (8) is the viscosity scale, (9) the torque thread, (10) the gauge support, (11) the base plate and (12) the cradle on which the housing rests.

The driving belt (13) transfers the power from the torque motor (14) which is mounted on a motor base (15), the position of which is adjustable on rails (16). Levelling screws (17) are provided for mounting the instrument in a horizontal position. (18) is the spindle pulley, (19) the motor pulley, (20) the spindle bearings, keeping the spindle (21) in position. (22) is the housing.

Fig. 7.—General layout of the continuously indicating viscometer, Type RHB. Inlet of liquid at A, outlet at B. Graduated scale (8) indicates viscosity

The viscometer will indicate continuously only if continuously fed. This may be done either by gravity or by a small pump. The indication of the instrument is practically independent of the rate of feed and any of the commercially available smaller pumps are suitable.

There is no appreciable time lag in the viscometer itself and, if it is placed near enough to the spot in which viscosity is representative of the process, the total time lag may be made very small, *i.e.*, a few seconds.

The housing is well insulated and can be safely exposed to an inside temperature of 200° C. Electric heaters will compensate for loss of temperature and provision is made for keeping the temperature constant at any temperature up to 200° C.

Recording and Control

The transfer of the indication to a recorder is a problem of its own and its full description is outside the scope of this paper. Briefly, the position of the indicator (in tube 3, Fig. 7) is picked up by electric means and the magnitude of the current passing in the circuit is registered on a recorder. The addition of suitable control gear will then keep viscosity constant or otherwise control automatically a portion or the whole of the plant.

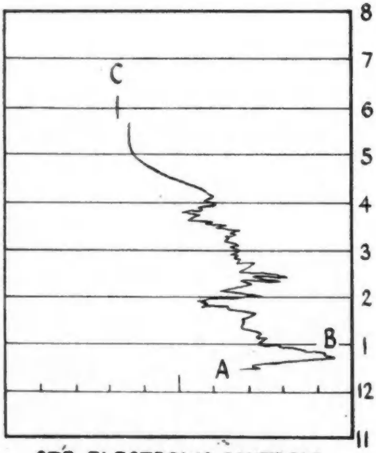


Fig. 8.—Viscosity record of a manually controlled process. Fluctuations due to rapid increase in viscosity, dependent on raw material, thermal and mechanical treatment of polymers

Fig. 8 shows the viscosity record of a manually controlled continuous process. On the right are the hours, while the horizontal graduations indicate viscosity.

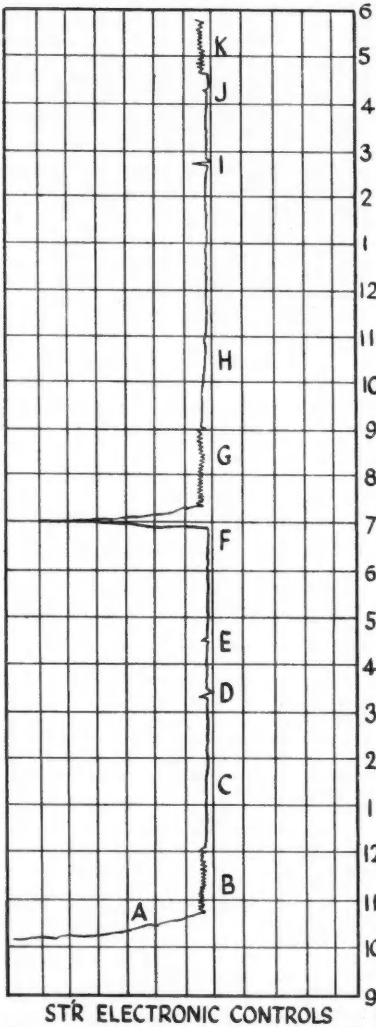


Fig. 9.—Automatic viscosity control. Record shows stable viscosity during period of continuous operation and effect of deliberate disturbances (D and E ; I and J)

In this particular process the product was collected in two tanks. One was fed each evening, the other during the odd hours. The arrangement was made in order to give the laboratory time to make the measurement on an average sample produced within the period of one hour and to apply a correction, if necessary, to comparatively small batches. It can be seen from Fig. 8 that the hourly average is only a very rough indication of what is actually happening.

The recording started at 12h. 25m. at A and viscosity reached peak B at 12h. 40m. A peak value of that magnitude did not occur again during the duration of the test. Viscosity was at a minimum just before 2 o'clock and kept on fluctuating until 4 o'clock. From now on the record indicates the gradual lowering of viscosity as the process finishes. To complete the picture the viscosity of the raw material was recorded, (*see line C*).

Controlled Viscosity

Fig. 9 shows the record of a process controlled automatically for constant viscosity. The plant consists of two units, one with a tendency to produce high viscosity material, the other with a tendency to produce low viscosity material. As a basis for controlling the whole process only the combined output of both units was available.

It was obvious from the outset that the conditions are not favourable for producing a straight line record, due to the fact that the controlling action was to be transferred from one unit to the other and that the comparatively large amounts of liquid in each of the units and in the pipes would have to pass through before a corrective action could be effective.

Therefore, a ratio control was planned by which the supply ratio of the two units could be adjusted; the success of this precaution is shown in the C and H portions of the record.

Method

The process starts at A, with viscosity coming up to a predetermined point. Thereafter the controller begins to regulate and the saw-tooth portion of the record (B) indicates a regular fluctuation of viscosity due to the changeover from one unit to the other. The ratio control was then put into operation.

This apparatus relies on the charge and discharge of a condenser in an electronic circuit which in turn actuates the two units intermittently at a preselected ratio.

If the viscosity is too high the regulator would normally (as in B) admit a low viscosity component for a very long time. With the ratio control in operation the flow of the low viscosity product is interrupted, admitting, after a while, some of the high viscosity product.

The action will automatically repeat itself until the controller has sensed an overall drop in viscosity. From now on only the high viscosity product is admitted and the admission will continue until the controller has taken note of the higher viscosity and puts the ratio control in operation again. The final result is as straight a line as can be obtained under practical conditions.

To check the action of the controller a large amount of low viscosity product was let into the common receiver at point D, but after a single cycle viscosity was again fully under control. A smaller amount of low viscosity product deliberately introduced at E called only for half a cycle before control re-established itself automatically. At F the process was shut down and the whole series of tests were repeated, F to K.

The reliable recording and automatic control of viscosity is a problem of considerable magnitude and requires specialised knowledge both of viscometry and of industrial control. It is, therefore, not surprising to find that attempts were made to achieve constant viscosity by controlling the factors which effect viscosity of the end product, such as temperature, pressure, rate of flow, duration of treatment, etc.

Measurement Indispensable

It is, however, obvious that the sum total of the individual fluctuations may be (and in most cases is) appreciable and that the most reliable basis for the control of viscosity is the measurement of viscosity.

The application of automatic viscometers can be considered only where the process is either very fast or where manual control would require too much personal effort. Processes and materials for which practical experience is already available include blown oils, various polymers, chocolate photographic emulsions, coating of paper with bituminous materials, processing of nylon yarn, synthetic resins and the blending of mineral oils.

Automatic control of viscosity removes a great worry and responsibility from the shoulders of the plant engineer in cases where a products of uniform viscosity has to be processed or produced in bulk.

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Modern Analytical Balances

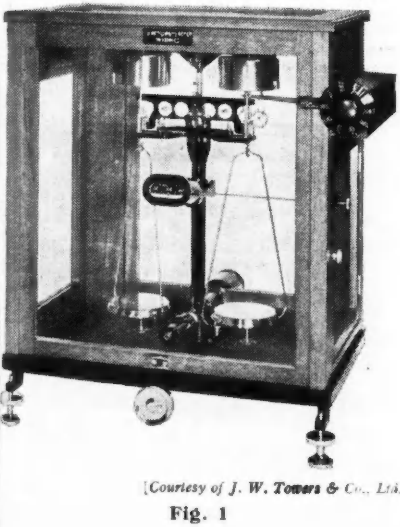
Growing Precision and Ease of Manipulation

by CECIL L. WILSON, M.Sc., Ph.D., F.R.I.C.

FOR the analytical chemist the most important instrument in his armoury—an armoury which proliferates with rather bewildering facility yearly—is still the balance, and it is difficult to envisage the day when this will not be so.

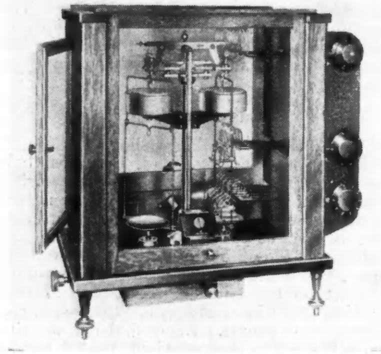
The instrument of twenty years ago is still for all practical purposes the ideal instrument for teaching the methods of analytical chemistry. Combining reasonable robustness of construction with a very satisfactory precision, its use instils in the receptive student the need for the careful handling of any instrument which is to be used for analytical purposes, and the requirements of care, cleanliness and method in working which are the first and foremost demanded in all competent practical work.

One has noticed with some apprehension a tendency, particularly in American journals recently, to laud the use of various rapid-weighing instruments for teaching purposes. The assumption is that thereby a considerable increase in the amount of work covered by a student will result. The corollary to this assumption, which is that the bulk of work rather than the quality is what matters, is patently absurd.



[Courtesy of J. W. Towers & Co., Ltd.

Fig. 1



[Courtesy of Stanton Instruments, Ltd.

Fig. 2

The present writer feels that the time spent in learning the proper use of the simple unmodified balance cannot be measured by the ordinary means of assessment, and that to slur over the preliminary work may do permanent harm to the technique of the worker.

The fundamental technique of weighing, and the precautions to be attached to it, are the same, no matter what make of balance is ultimately to be used. And these must be thoroughly learned. While a trainee should have some familiarity with the various modified types used in industry, in addition to the ordinary balance, the bulk of his training work should still, so to speak, be carried out from first principles. This applies equally to the university student and to the trainee in industry.

The Analytical Balance

When one turns to industrial practice and to specialised techniques one finds a different state of affairs. Demands are different and the workers have already received their basic training. In the ordinary industrial laboratory, time-saving is often an essential factor in several ways. The works requires to have a quick answer to its problems, and time consistently saved must result in the possibility of a greater volume of work. The third is a psychological factor: the worker who has many routine weighings to carry out will welcome any device which will efficiently reduce the time which he has to spend on each weighing.

It is not surprising, therefore, that over the past 20 years the efforts of balance makers have increasingly been directed towards speed and ease of manipulation. The most advanced types of routine analytical balances now include one or more devices to permit this. Probably the most important are damping, projection reading and automatic fractional weight addition The precise mode of achieving these improvements varies from maker to maker, but representative examples are shown in Figs. 1 and 2.

Easy Reading

The air-damped balance shown in Fig. 1 is sensitive to 0.1 mg., and, like most balances of this type, does not require weights below 1 g., decigrams being added by means of the two concentric dials at the right-hand side of the case, which lower the appropriate ring riders on to a projection on the beam. The white scale on a black background is particularly easy to read in normal lighting conditions, and gives the last three places of decimals. Each division on the projected scale is equivalent to 0.2 mg.—the common practice in this type of balance.

The one point of criticism which the author has here concerns the front release for the beam, with which he is never happy. But this is a personal like or dislike.

The balance shown in Fig. 2, also air-damped, carries the process of ease of manipulation a stage further. The air-damping cylinders are slung below the beam instead of above. The best position for these is a matter of some controversy, but it is probably true that if, when slung below, they do not unduly restrict the free space above the pan, positioning does not matter much.

The principal difference from the previous balance is that the last two places of decimals are read direct on the projected scale, while all other weights, up to the total capacity of 100 g., are added from outside the balance by the set of dials on the right-hand side.

This "instrument board" may at first sight look formidable in its complexity, but, as with any of the dial instruments, the initial confusion resulting from a new mechanical operation is soon lost, and thereafter the advantages are obvious. In the first place, the actual counterpoising is a much more rapid operation than when using ordinary weights.

The weights themselves are considerably less likely to suffer deterioration, since they can normally receive no direct handling, nor can they be accidentally dropped. And finally, after the object to be weighed is placed in the balance case, all subsequent operations are performed with closed doors, which is, of course, the ideal state of affairs.

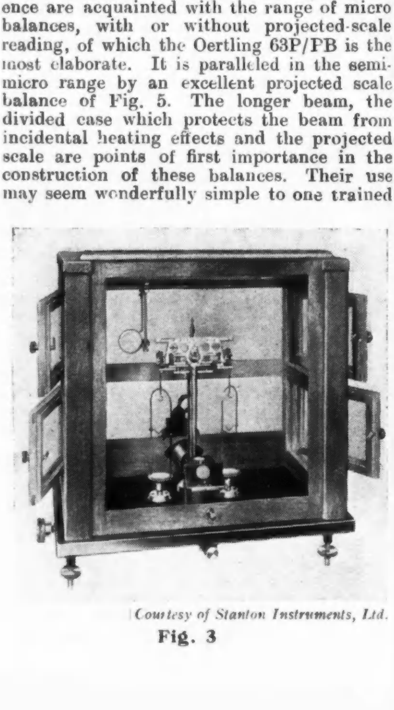
A further point of interest about this balance is that the bearing planes, traditionally of agate, are here made of synthetic sapphire. It is claimed by the manufacturers that on account of its considerably greater hardness, sapphire is more enduring for this purpose. Comparative endurance tests which have been carried out showed that a set of sapphires kept constant sensitivity for about two and a half times as long as a set of agates. It is to be presumed that the problem of grinding a sapphire knife-edge has not yet been solved economically.

In special techniques, semi-micro and microchemical weighing, the lag which existed in this country before the last war has disappeared, at least as far as the adequacy of the apparatus is concerned.

The balance shown in Fig. 3 follows the traditional pattern of the Kuhlmann balance, which was the prototype of German microchemical balances. For a number of years at least one firm in this country has broken away in many respects from the traditional pattern, with results which thoroughly justify the innovations.

Microchemical Balances

Most analytical chemists of any experience are acquainted with the range of micro balances, with or without projected-scale reading, of which the Oertling 63P/PB is the most elaborate. It is paralleled in the semi-micro range by an excellent projected scale balance of Fig. 5. The longer beam, the divided case which protects the beam from incidental heating effects and the projected scale are points of first importance in the construction of these balances. Their use may seem wonderfully simple to one trained



Courtesy of Stanton Instruments, Ltd.

Fig. 3

on the old Kuhlmann type, particularly the kind which lacked even telescopic reading of the pointer scale.

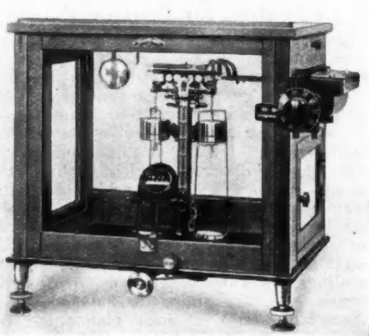
Recently some German models have been reaching this country. The Bunge microchemical balance does not, on the whole, make a good comparative showing. The projected scale is very short to anyone accustomed to the Oertling scale, although reading can be simplified somewhat by placing a large low-power lens in front of the projected scale.

Since the scale has to be estimated to 1/10 of a division, the lens is practically essential if the operator is to keep his head sufficiently far from the balance. In addition, the traditional inclined side doors of the Bunge case make reading of the rider at extreme positions on the rider scale extremely difficult. Many, too, will prefer a black glass base rather than the pale marble base of the Bunge, which does not show up dust at all well.

Aperiodic Microbalances

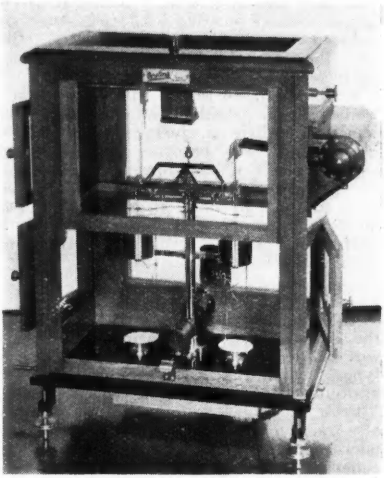
There was considerable controversy for a number of years as to the possibility of successful damping of the microblance. The first reports from Germany immediately after the war tended to show that German manufacturers had solved a problem which up to that time had admittedly not been solved here. Further investigation showed there had been confusion of nomenclature, which had led on occasion to British manufacturers being blamed unjustly.

Germany was using a balance—exemplified by the balance shown in Fig. 4, now reaching this country—which had a claimed sensitivity of 0.001 mg., while here it was repeatedly insisted that the sensitivity was only 0.01 mg. It is now clear that, owing to different uses of the term "sensitivity," both statements were correct. The final place of decimals on the Sartorius, for example, is estimated as tenths of one scale division.



[Courtesy of Laboratory Suppliers, Ltd.

Fig. 4



[Courtesy of L. Oertling, Ltd.

Fig. 5

The writer has always had an open mind regarding the merits of air-damping of microchemical balances, although many of the arguments apply here as to ordinary analytical balances. It is certain that a gain of speed in weighing can only be achieved at the expense of some loss of precision. Thus an ordinary analytical balance with a notched beam, while usually quoted by the manufacturers with a sensitivity of 0.1 mg., may easily, if in good condition, have a precision of 0.025 mg. But no aperiodic balance, in the author's experience, can show this reproducibility.

Likewise, a non-damped microchemical balance with a rated sensitivity, on the usual manufacturer's convention, of 0.001 mg., will probably have a precision of 0.002 or 0.003 mg., but if damped the factor is bound to be increased.

Only considerable experience of a range of damped and undamped balances will settle that point conclusively, and meanwhile it is good to note that a British-made air-damped balance falling into this category has reached the production stage in this country.

Comparison of the claims for this balance, shown in Fig. 5, with the performance of the Sartorius balance already mentioned would seem to show little difference in principle. Wisely, the makers point out

that they have taken as a model their full microchemical balance with the sensitivity reduced one-tenth. Consequently, they give the safer, and less misleading sensitivity of 0.01 mg.

There seems no reason to suppose that it would not be possible to estimate to one-tenth of a division, just as with the Sartorius, and it is to be noted that the British balance has the advantage of the longer, more stable beam, and the divided balance case. It has, in addition, a maximum load of 30 g., as compared with 20 g. for the Sartorius. In both balances fractional weights are added externally.

Anomalies of Delivery

An unfortunate thing is that, owing to the general delay in securing deliveries, it will be some considerable time before this type of balance will be available to all who need it.

Prior to the last war Germany was generally regarded as the normal supplier of microchemical balances, a custom which ended when war needs made it essential to produce such balances here. Now having reached the position of being able to manufacture microchemical balances which, in this writer's opinion, are second to none, we have to wait months, probably more than a year, for delivery.

The prior needs of the export trade make it incumbent on scientific workers to bear the deprivation with fortitude. At the same time, it must be remembered that the export drive depends in the first instance on the possession by industry of adequate scientific instruments. It is galling to note that the delivery time for at least one German balance is quoted as four weeks.

Laying aside all question of the relative merits of the British and German balances, which are closely related, and discounting for the moment personal prejudices about buying in home or foreign markets, it is clear that an anomalous situation has arisen. If a balance of this type is required urgently, the worker may be forced to buy the German balance. To be forced to patronise a foreign article which we have shown we are capable of equalling and even improving upon is lamentable. It echoes equally curious occurrences in British industry after 1918.

The mention, above, of conflicting definitions of sensitivity leads to the observation that for the analytical worker it is often more important to know the precision of his instrument. So far as the writer knows, no manufacturer is bold enough to quote, at least officially, a precision for his products. It might, perhaps, be a counsel of perfection to ask that this figure be quoted freely, but reliable information on the expected or average performance of balances would often, one feels, be a considerable inducement to purchase.

The author knows from experience that of half-a-dozen makes of balance which he has tested in this respect, all with a claimed *sensitivity* of 0.1 mg., the *precision* has varied from ± 0.015 mg. on the one extreme to about ± 0.2 mg. on the other. To quote, without qualification, a sensitivity of 0.1 mg. when the precision is ± 0.2 mg., could be, to say the least of it, misleading, unless one were fully aware of the existence of such a variation. Indeed, the author knows laboratories which have incautiously overlooked this point in the purchase of balances, to their ultimate regret.

One cannot leave the subject of balances without reference to prospective developments. Mechanically, the balance would seem to have reached a high peak, and any notable extension of its function will probably be in the direction of improved sensitivity.

Neglected Type

So far, however, no maker in this country appears to have tackled the problem of the sub-micro balance.

As a consequence, the would-be workers in this field require workshop facilities of a high order if they wish to tackle gravimetric work on the microgram scale, making their own balance and keeping it in repair.

Presumably the demand for a balance in this range has not yet justified its commercial supply, but modern developments in chemistry would leave little doubt that for analytical purposes and for general chemistry the microgram balance will before long come to have a function much more common than would have seemed possible a decade ago.

Corundum for Bearing Planes

What promises to be a major advance is represented by the use by L. Oertling, Ltd., for bearing planes, of corundum in the place of agate. The chief advantage of this crystalline alumina substance—now grown as large synthetic crystals—is its external hardness (9, Moh's scale), second only to that of the diamond, which enables it to retain optical flatness considerably longer than conventional materials. The principle has been subjected to rigorous tests, using an electrical device which automatically operates the balance continuously, and the readings, after the equivalent of 20 years' normal use, are stated to have shown no appreciable error. Such planes are now fitted to all Oertling prismatic, analytical balances.

New Laboratory Equipment

Recent Examples of Better Design

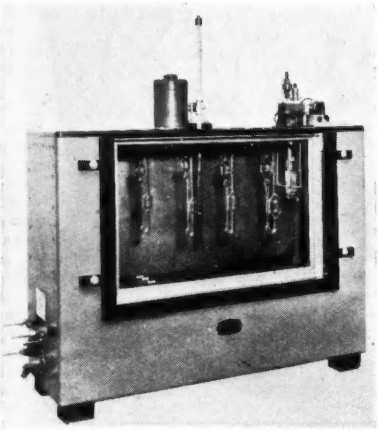
by I. C. P. SMITH, B.Sc., F.R.I.C.

ONE of the instruments which must attract considerable attention this year is the new constant temperature bath put on the market by Townson & Mercer, Ltd. This, the S.200, is the result of many years' development, and a constancy of temperature of the order of .001° C. is claimed, this being as close as modern methods of temperature measurement can indicate.

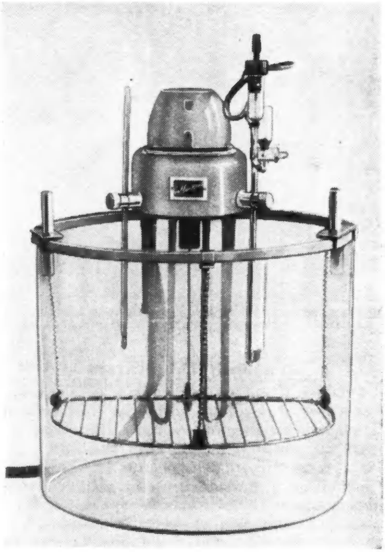
Into this achievement has gone a wealth of design and detail, in which no single item has been omitted which could influence the result, no matter how awkward the individual part may have been to manufacture. This bath is naturally not everybody's toy and will be available only to those organisations which can put down a considerable sum for laboratory equipment.

In achieving their object, the designers have concentrated on certain essentials; effective stirring, efficient insulation and low heat capacity of the surrounds. A mercury U-tube thermo-regulator gives very rapid response, is positive in action, and eliminates errors due to ambient temperature.

The electrical equipment incorporated in the design gives lively response and permits quick adjustment to a change of set temperature.



New thermostatically controlled bath (Townson & Mercer, Ltd.)

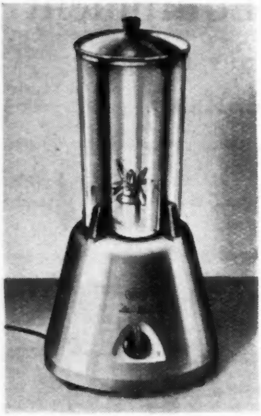


Thermostatic bath No. 14026. (A. G. Gallenkamp & Co., Ltd.)

As these baths will be used particularly for viscometry, the arrangements for mounting the viscometer have been treated with an exactitude and forethought appropriate to the remainder of the construction.

Another recent noteworthy addition to the range of thermostatic baths comes from A. G. Gallenkamp & Co., Ltd. (shown here). This, an attractive addition to the lower-priced category, is constructed round a cylindrical heat-resisting glass vessel. A neatly designed casting carries the stirrer motor and the heaters, together with clamps for the thermometer and thermo-regulator, and is connected to the control box by a multicore lead.

The range with the standard heaters is up to about 60° C. with an accuracy ±.05° C., but alternative heaters are available for higher temperatures. The simply designed fittings include an adjustable wire shelf and supports for viscometers.



The Ato-mix (Measuring & Scientific Equipment, Ltd.)

Vacuum Desiccators

Produced by the same firm is a vacuum desiccator of original and robust construction; the body and the lid are light alloy castings, with a glass window let into the lid. The joint faces are machined, and the seal is effected by a moulded rubber gasket. The desiccant, with a working space of 10 in. diameter, and 6 in. deep, is carried in a porcelain dish in ribbed supports under the perforated plate. Absolute safety against collapse under vacuum is assured.

Melting Point Apparatus

In the T. & M. melting point apparatus in its latest form the viewing tube has been set up at an angle, making for easier observation of the specimen and the reading of the thermometer. The heating control is elaborately worked out to be progressive, as well as giving rapid heat-up when required.

Inviscerators, or high-speed stirrers provided with cutting edges, have come into the news recently, having moved from the kitchen where they are employed for preparing macerated foods, to the chemical and biological laboratory.

The essential of the laboratory form of the instrument are a stainless steel stirrer having four staggered sharpened blades running at fully 10,000 r.p.m. in a glass vessel whose lobed sides throw the mixture back to the stirrer. They reduce vegetables, meat, small animals, or animal parts with water to a broth in a matter of minutes.

Two types of construction have been employed. The one has a top drive, and the motor and stirrer may be swung up out of position; and in the other the stirrer is driven through the bottom of the vessel, the stirrer in its bearing being a fixture in the vessel, thoroughly sealed against leakage. The drive is by a splined or squared shaft from the motor beneath, so that the vessel may be easily lifted off or replaced on its rubber mountings.

The chief problem in the overdrive type is to maintaining rigidity in the stirrer at high speeds. The problem appears to have been solved by providing close to the stirrer a lower bearing carried in a stainless steel extension from the motor casing. A scoop-shaped member shown in a Townson and Mercer form of instrument is intended to assist in washing the stirrer down into the vessel after a run.

A safety switch is provided which cuts out when the motor is raised through a small angle; it is a very necessary safety device, which should not however be used instead of the switch provided for controlling the motor.

The Ato-mix follows the more conventional pattern of these inviscerators, with its under drive, and the design as a whole indicates an informed and sympathetic approach to laboratory needs. Among its refinements are a half-speed and full-speed

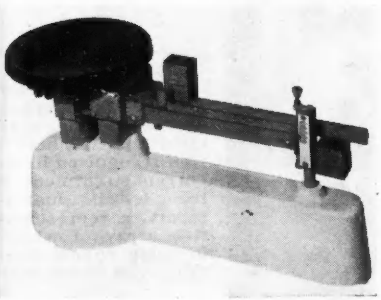
The simple and robust design of this inviscerator recommends it for high-speed mixing and maceration in the laboratory (Townson & Mercer, Ltd.)

The M.S.E. medium centrifuge

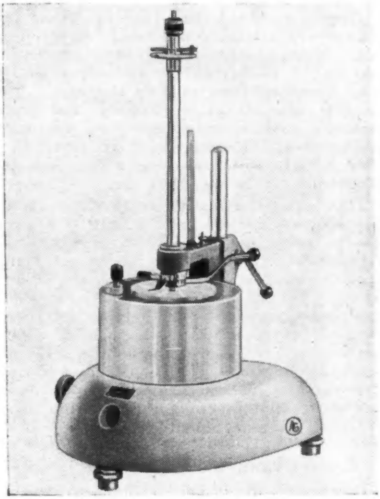
switch, the latter giving approximately 12,000 rpm under load, and a suppressor to prevent interference with radio or television reception.

The makers of the Ato-mix have been of which the major and minor centrifuges, specialising in microtomes and centrifuges the former of 2200 ml. and the latter of 200 ml. capacity, were described in THE CHEMICAL AGE review.

There is now a further model, the Medium, to bridge the gap with a capacity of 1000 ml. This is very much a "modern" design, and, besides covering all the familiar requirements, it may be supplied with three swing-out heads or four angle heads, to carry a number of different combinations of tubes. All these heads are interchangeable on the basic unit. Like



Robust small laboratory balance, Type TB. (E.T.A. Instruments, Ltd.)



Compact, small viscometer (A. Gallenkamp & Co. Ltd.)

the Major, it may be fitted with a separate super-speed attachment, carrying six 7 ml. tubes, and running up to 16,000 rpm.

An addition to the Minor range is a "chemical" centrifuge with stainless steel perforated basket of 300 ml. capacity, running in an enamelled steel or stainless steel draining chamber. The basket has a diameter of 5 in. and may be rotated up to 4000 rpm.

The E.V. Viscometer

The Gallenkamp organisation has long been known for its torsion wire viscometers; to this range is now added the E.V.T. (equiviscous temperature) viscometer, an instrument particularly adapted to the examination of tars and pitches. It has been found in practice more convenient to quote this figure, which is the temperature at which the substance has a certain predetermined viscosity, than the older method of quoting viscosity and temperature figures.

The viscometer comprises a tar cup in an electrically-heated water-bath, with the rotating cylinder forming an annulus of tar, the cylinder being connected to a flywheel and the torsion wire suspension.

The viscosity is measured by the over-run of the flywheel when it is given an 180° impetus, and in this case the temperature is adjusted until a predetermined over-run is achieved, indicated by fixed marks on the flywheel. The instrument is very soundly constructed, and is well devised to ensure simple and speedy operation.

Among the new balances this year one which will attract considerable attention is the Stanton quick-weighing aperiodic, having all the weights, totalling up to 100 gm., operated from outside the case. The weights are all nickel-chrome, and great accuracy and increased speed of operation are claimed. The same firm have now added a micro balance to its range, with a capacity of 20 gm., sensitivity .001 mg.

The new E.T.A. triple beam balance has already attracted much attention as a solidly made job for all rough weighing in the laboratory. It has the feeling of being very solidly constructed, and the riders locate themselves comfortably in their appropriate notches. It would be improved by the provision of a scale-pan or scoop which would take the whole of the 2110 gm. of, say, precipitated chalk, instead of having recourse to the use of stiff paper as a secondary container on the existing pan, with the necessary counter balancing.

Graduated Glassware

These notes would not be complete without reference to the new E-Mil brand of graduated glassware. Apart from the guaranteed accuracy, and the scale of production which H. J. Elliott, Ltd., has achieved, it is particularly gratifying to note that a firm in this country has at last standardised vitreous enamel-filled graduations, standardised packaging for all articles, and not least, has produced a simple, unbreakable stopper, which will not seize. It represents one of the most appropriate uses of a plastic which is proof against all aqueous solutions, and most organic solvents. These have been undergoing rigorous tests at the National Physical Laboratory, the result of which, it is believed, will support the approval which laboratory users have given in recognition of its practical advantages.

The same objective, the lightening of the laboratory worker's task, has earned wide acceptance lately of Elliott's drop type Beckmann thermometer.

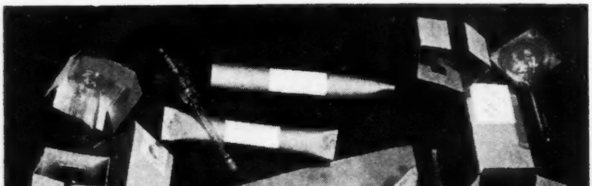
In the past, Beckmann thermometers have sometimes been difficult to adjust, and very prone to get out of order in transit, so that even experienced users very often have to send them back for readjustment.

The new type is "fool-proof" in this respect, and when the user wishes to reset the thermometer to a different temperature range on the scale, he is able to do so readily without a lot of trial and error. This is due to the fact that as the mercury passes through the trap at the top, he has merely to count the drops of mercury, which are given a definite true temperature value etched on the scale.

The new range is said to have had marked success in the export market, both from point of view of exclusive new improvements in the apparatus itself, and in appreciation of the protective carton packaging.

ELECTRIC THERMOMETER

AN electrical thermometer, designed particularly for the many industrial applications where remote indications are necessary, has been announced by the Weston Electrical Corporation, Newark, N.J., U.S.A. It employs a recording element, a "resistor bulb," which is readily placed in tanks, grain bins, machines, and other equipment with the direct-indicating instrument mounted any reasonable distance from the bulb. Using a selector switch and multiple bulbs, a number of temperature measurements are said to be possible with only one indicating instrument.



Efficiency in packaging is—in glassware at least—as important as competent construction. This is well recognised in the current treatment of the E-Mil instruments, a representative array of which, in their robust containers, is shown here

[Courtesy of H. J. Elliott, Ltd.

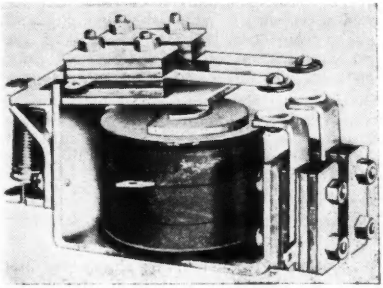
FURTHER DEVELOPMENTS IN DESIGN

Modifications in Electrical and Other Equipment

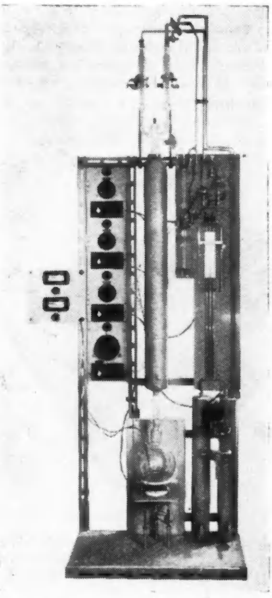
From a Special Correspondent

THE belief that economic prosperity in this country depends almost as much upon increased industrial instrumentation as it does upon intelligent deployment of labour and materials claims a greater following today than it ever enjoyed before. Its acceptance imposes on British makers of scientific and industrial instruments a heavier responsibility than at any time since the need for war production called for all the inventiveness and industry they could muster.

While the flow of "new" scientific instruments has in the past 12 months been only slightly less ample and varied than in 1947-48, the principal trend has been towards the consolidation of the new designs and principles latterly introduced. To this there have been a few noteworthy exceptions, but they have been insufficient to upset the conclusion that most of the advances made in 1948 have been in the direction of improving, operationally and aesthetically, the enlarged range of equipment made available since the war.



The midget relay, part of the new series of miniature super-sensitive instruments for automatic control. (Londex, Ltd.)



Small-scale fractionating column (18in.) for laboratory use. (Griffin & Tatlock)

While it would have been shortsighted policy to have omitted this period of consolidation, there remains to be explored in 1949 wide scope for renewed inventiveness and for improvement of design, particularly in the direction of greater simplicity and lower cost.

In the application of new materials to the uses of the chemical laboratory interest has centered on substances having special electrical properties, such as high dielectric constant or high magnetic permeability. At the Physical Society's recent 33rd exhibition of scientific instruments were several applications of artificial single crystals and there was one new industrial adhesive with remarkable properties as a metal-ceramic bond.

Analytical Balances

In the chemical laboratory, improvements in the design of analytical balances had been made, and in one case (Oertling) synthetic corundum plates had been substituted for the traditional agate, resulting in greatly improved life.

Griffin & Tatlock has now an excellent high efficiency laboratory fractional distillation apparatus with three alternative types of column; a 5 ft., 40-plate column packed with glass Fenske rings, and 18 in., 50-plate column with a stainless steel gauze ring packing and, lastly, a 54-in. 7- or 14-plate column packed either with short lengths of glass tube or with Fenske rings.

Among the microscopes, always outstanding examples of the instrument makers' art,

two innovations are worth noting. Cooke, Troughton & Sims is now providing a phase contrast microscope in which both the phase and the relative amplitude of the two beams can be varied, to obtain the best conditions for observing different kinds of specimen.

W. R. Prior and Co. has designed an inverted microscope in which the stage is placed above the objective lens, thus permitting the rapid examination of the surfaces of large objects without the need for taking replicas.

Of three electron microscopes shown at the Physical Society's exhibition one, the Philips instrument, is new, and of radically different design. Its performance is comparable with that of the others, but it is undoubtedly the simplest to operate.

The Spectrometers

Two complex instruments which are becoming increasingly important to the industrial chemist, particularly the oil technologist, are the infra-red spectrometer and the mass spectrometer. Sir Howard Grubb, Parsons & Co. has demonstrated an excellent double beam infra-red recording spectrometer having a resolution of the order of one wave-number. The instrument provides a record of percentage transmission of the sample, and is independent of fluctuations in the output of the Nernst Filament source.

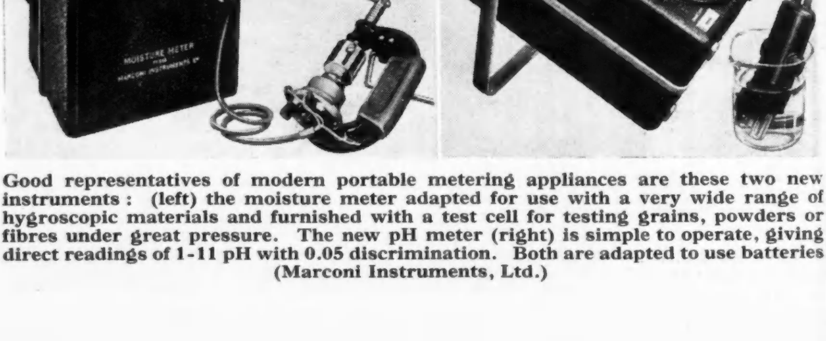
The mass spectrometer which the Atomic Energy Research Establishment has produced to cover the range of masses up to 50, derives a special interest from the fact that it had been built almost entirely from standard service electronic units, so that its cost was comparatively low.

Metropolitan Vickers, Ltd., now has a simplified version of the previous universal mass spectrometer, the range being restricted to masses up to 70. In addition to isotope estimation in tracer work, both of these instruments can be used for rapid gas analysis.

Among the wide range of instruments now being offered for industrial process metering and control the rate of development of design has not been very rapid. One temperature controller (The Foster Instrument Co.) is notable in that it provides for continuous control of the furnace power input instead of the usual intermittent operation.

Several photoelectric colorimeters or colour comparators are now being offered or demonstrated. Some, such as those designed by the NPL and the General Electric Company, are large and costly precision instruments in which the light is dispersed into a spectrum before being measured. Others, relying on combinations of coloured filters and barrier-layer photocells, may serve a useful purpose as comparators for a limited colour range but would be most unreliable if used as general purpose instruments.

Of interest to colour chemists is the Siemens Colour Matching Unit which represents a considerable advance on anything of this kind. By a combination of a special fluorescent lamp with a tungsten filament lamp a very good approximation to daylight is obtained with a high efficiency.



Good representatives of modern portable metering appliances are these two new instruments : (left) the moisture meter adapted for use with a very wide range of hygroscopic materials and furnished with a test cell for testing grains, powders or fibres under great pressure. The new pH meter (right) is simple to operate, giving direct readings of 1-11 pH with 0.05 discrimination. Both are adapted to use batteries (Marconi Instruments, Ltd.)

Chemicals and Plant at the B.I.F.

WITH the opening on Monday next of the 28th British Industries Fair, home and overseas buyers will be offered in London the most comprehensive review of chemicals, plastics and scientific instruments of any presented in the centres of world trade, and at Castle Bromwich, Birmingham, will be seen as representative an array of heavy chemical plant, mineral and metal-working machinery.

When the final lists were being completed it was indicated that British chemicals would be represented by 69 exhibitors on the ground floor of the Grand Hall at Olympia. Their stands will occupy nearly 25,000 sq. ft. in the location, left of the main Addison Road entrance to the exhibition, where chemical industries were grouped last year. The fact that there has been very little change in the scheme and facilities since last year testifies to the effectiveness of the 1948 procedure.

New Layout

The only exception of note is the modification of the layout of stands decided upon in collaboration between the Export Promotion Department of the Board of Trade and the Association of British Chemical Manufacturers, which is again helping to co-ordinate this section and will offer facilities to assist buyers. The new pattern in which chemical displays have been arranged—large stands grouped at the corners and the centre of the area, linked by the smaller displays—will distinguish the section from those neighbouring it.

Another aid to quick identification is being provided by a novel arrangement by Shell Chemicals, Ltd. (B13), consisting of large-scale models of the three centres of the Fair. Intermittently, chosen sections of the various models will be lit up, to correspond with the spot-lighting of the particular Shell chemicals employed by the industry singled out.

> ## "C.A." STANDS
>
> THE CHEMICAL AGE *will again be represented at London and Birmingham on the stands of its proprietors, Benn Brothers, Ltd., where all information relating to the journal, "The Chemical Age Year Book," and the many other affiliated industrial publications will be available.* THE CHEMICAL AGE *will be found at these stands:—Earls Court, No. V.5 (Fulham 8996). Olympia, No. A.13 (Renown 5148). Castle Bromwich, No. A427 (Fair 213).*

Almost as much space (24,000 sq. ft.) is taken up by the displays of scientific and optical instruments, which 121 firms will represent on the same floor as chemicals.

Plastics

Plastics exhibits will again be at Earls Court, where 53 exhibitors have booked rather more than 20,000 sq. ft. of exhibition space. Buyers visiting this section will approve of the more orderly arrangement of stands which has been adopted. Now the industry is being represented in three well-defined groups—plastics materials, commercial moulders and fabricators, and proprietory articles made of plastics.

Many newcomers to the range of commercial chemicals will be seen on the stands in the London exhibition centres, some of which are briefly described here.

Some London Exhibitors

A. BOAKE, ROBERTS & CO., LTD. (STAND B33).—Many hundreds of samples of fine chemicals, perfume essences and perfumery chemicals, etc., are being shown, among them an acetophenone of extreme purity expected to have a wide application in the future as an intermediate, as a basis for synthetic resin and as a solvent. Its cost, in the past, limited its use to such purposes as perfumery. Its lower cost permitted by large production has opened new prospects. Samples of a new anti-frothing agent will also be available for examination on this stand. The new product—Y4—is now offered as an effective agent in all cases of foaming, to prevent the delay, loss and damage incurred in many chemical operations. Samples of two other new Abrac products, Abrac lye (an absorbent for H_2S and CO_2) and mono cresyl glyceryl ether, will also be shown.

BRITISH INDUSTRIAL SOLVENTS, LTD. (STAND B69).—The current enlarged display reflects some of the effects of the £2 million new capital expenditure at the company's Hull works, authorised two years ago. More than 80 products of fundamental interest to chemical manufacturers are now being prepared, and most of these will be represented. The "Bisol" range of solvents, plasticisers and chemical intermediates, comprising alcohols, aldehydes,

acetals, ketones and esters, has been widened to include the two important ketones, methyl ethyl ketone and methyl isobutyl ketone, and a number of the newer alcohols and esters, such as methoxybutanol and acetoacetanilide, diallyl phthalate and methyl acetoacetate.

THE GENERAL CHEMICAL AND PHARMACEUTICAL CO., LTD. (STAND B55).—This exhibit will show some typical examples from a wide range of laboratory chemicals, analytical reagents, acids, electrolytes, etc. Prominence is being given to the Judactan series of analytical reagents with actual batch analysis.

I.C.I. Review

IMPERIAL CHEMICAL INDUSTRIES, LTD. (STAND B18/27 and Earls Court, STAND X21-34).—The group is following its usual practice of devoting its main stand to the story of one of its manufacturing divisions. This year it is the turn of the General Chemicals Division. Models, photographs and coloured transparencies, are being used to illustrate how the division's 150 products —most of them based on chlorine or sulphuric acid—are employed in the service of industry and in the daily life of the community. Emphasis is also being given to sodium cyanide, another of the division's products, used for casehardening steel and for extracting gold from crude ore. It is also one of the raw materials of Perspex. The cerium "flints" used in gas and cigarette lighters, and the Gammexane insecticides, which were discovered in the division's laboratories at Widnes, will also be well represented.

The newly developed product of the Plastics Division, polytetrafluorethylene (Fluon) will be the most interesting exhibit of the I.C.I. display at Earls Court. It has many outstanding properties, in particular, extreme chemical inertness and solvent resistance, excellent electrical properties, and good mechanical properties at high temperatures. It remains flexible at temperatures down to about 70° C., and does not melt below 327° C. Samples of Fluon, as a fibrous white powder, and specimens of various types of industrial mouldings will be displayed. The advantages of nylon strings for tennis and badminton racquets and the possibilities of Alkathene film for packaging will also be represented. Its flexibility and toughness at low temperatures make it particularly suitable for the packaging of frozen foods.

KODAK, LTD. (STAND C71).—A precision-made document copying unit with automatic focusing to ensure accurate reductions of subjects up to 20 in. by 30 in. in size will be among the new products here. Reduction range is from 20 :1 to 8 :1 and no special skill is required in operation. A foot-switch releases the camera shutter and advances the film for the next exposure, the operator being free to handle the documents. A detachable magazine holds 100 ft. of 35 mm. microfilm—enough to record 800 originals at full frame size (24 mm. by 36 mm.), 1600 at half frame size (24 mm. by 18 mm.). The apparatus occupies 36 in. of floor space and the document table is 30 in. by 26 in.

MAY & BAKER, LTD. (STAND B47).—This stand will provide well-appointed rooms for interviewing friends and prospective buyers. A centre display unit of nine panels will indicate the scope of the M & B organisation, symbolising the story of the different groups of M & B products in the service of art, science and industry. Overseas visitors will be particularly interested in the extended uses of methyl bromide, of the RAF wartime fire extinguishing component, now finding increasing application for the fumigation of dried fruits, cereals, tobacco, and most recently, groundnut seed required for the East African groundnut scheme. Technicians already familiar with May & Baker's photographic chemicals and developers, will be interested in Genochrome, a more stable colour developer than has been available hitherto. In addition to panels dealing with M & B horticultural chemicals, aromatics and plastics, there will be others devoted to M & B pharmaceutical and ethical products, among which the barbiturates Allobarbitone and Amylobarbitone are new.

Petroleum Chemicals

PETROCHEMICALS, LTD. (STAND B17).—To supply all the technical information now being sought about the petroleum-derived chemicals now being produced at the plant at Partington, near Manchester, the stand will be staffed by technicians able to provide details of products and processes. The first types, now being shown, are benzene, toluene, xylene, aromatic solvents and plasticisers and pitch. These, of course, represent only a promising beginning; by the Autumn it is anticipated that there will be available in bulk, isopropyl alcohol, isopropyl ether, ethylene oxide, ethylene glycol, naphthalene, hydrocarbon resins and para-tertiary butyl phenol.

JOHN E. STURGE, LTD. (STAND B7).—Exhibiting for the first time, this company is giving equal prominence to two main products—precipitated calcium carbonate and citric acid. The former section will symbolise the chemical processes by which quarry limestone is converted into the fine chemical ready for use in such widely differing industries, and a demonstration bench will add a

practical note with apparatus for the Sturge Drop Test (the widely accepted standard test for determining the density of dry PCC). The citric acid section will present photomicrographs of mould cultures and some growing moulds will also be shown under magnification.

J. W. Towers & Co., Ltd. (Stand C37).—This stand will reveal a number of new items of scientific laboratory equipment, such as the addition to the range of analytical and air-damped balances, the Model 85 precision analytical balance which has a sensitivity of 0.05 mg., and is fitted with agate cups and points and other refinements. The Towers glass isomantles are safe flash-heaters for inflammable liquids, and for the distillation of high boiling point liquids with accurate control. Temperature control is by a Simmerstat unit which is placed well away from the mantle itself, avoiding all fire risk. A new universal oven has been designed on modern lines to cover the majority of the requirements of the average laboratory. It is finished in cream enamel and chromium plate, is well insulated with glass silk, and has accurate thermostatic control from 40-180° C. The standard size is 14 in. by 12 in. by 12 in.

A Pre-View of Some Midlands Displays

A PRELIMINARY survey is given here of some of the important new materials in the metal and engineering fields which will be seen at the Castle Bromwich, Birmingham section of the Fair.

Fredk. Braby & Co., Ltd. (Stand B609/508).—Included here are a structural steel building framework incorporating metal windows, metal partitions, doors and dovetail sheeting, while the free standing exhibits include pressed steel stairs, door frames, tanks, cisterns and cylinders, ventilators, cutters and pipes, barrows, roof-lights and aluminium tiles. Other free standing exhibits are typical examples of a wide range of products in metal for the chemical, oil, food, agricultural and other industries, including steel drums, air receivers, ice moulds, bins, perforated metals, culverts, aluminium products, cattle troughs, barrows, wire machinery guards, etc. A series of moving pictures illustrates various contracts carried out by the firm.

Reaction vessel in solid silver with cast iron jacket, used for corrosive medicinal intermediates. (Johnson, Matthey & Co., Ltd.)

Largest Electrical Equipment

The British Thomson-Houston Co., Ltd. (Stands C51 and 410).—Situated in the electrical section at Castle Bromwich, this exhibit is believed to be probably the largest single piece of electrical equipment ever shown at the B.I.F. It is a 275,000-volt oil break circuit-breaker unit designed for use in large outdoor switchgear installations. This exceeds 10 tons in weight, stands over 23 ft. high from the ground to the tops of the insulators, and has an oil tank—shaped like a watch case—over 10 ft. in diameter and 6 ft. in depth. The short-circuit breaking capacity is 3½ million kVA, the total break time being about 1/15 sec. BTH gas turbine work will be represented by a model of a 1200 h.p. gas turbine-alternator for marine propulsion. Another marine exhibit will be the latest BTH marine radar display unit, while models will show a typical marine radar layout on board ship. A standard "Emotrol" (electronic motor control) equipment will be demonstrated. In addition to a comprehensive selection of Mazda lamps and Mazdalux lighting equipment, the exhibits will include fractional h.p. motors, geared-motor units of various sizes, ½ and ¼ h.p. industrial "die-cast" motors, and several types of industrial control gear units. A thrustor has been modified for exhibiton purposes by replacing the standard oil tank by one made of "Perspex", enabling visitors to see the simple

but effective operation of a BTH thrustor under actual working conditions. There will also be stator and rotor units for building into machine tools; suds pumps; "Fabroil" silent gears; "Windonuts" for oil-level inspection and similar applications. Some large photographs will recall the important part being played by BTH in the provision of heavy electrical plant and equipment for the generation of electric power and its application in industry.

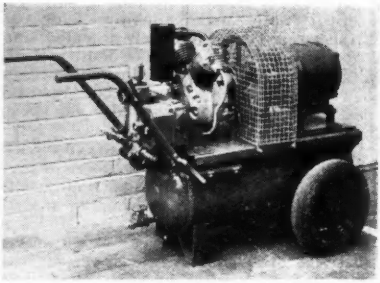
British Gas Council (Stands C619 and 518.—Included in this exhibit is a gas-fired annealing oven for glassware. The furnace, manufactured by the J.L.S. Engineering Co., Ltd., is used for annealing the finished articles and is claimed to eliminate any strains which may have been set up during the processing operations. Also being shown are automatic controlling and recording instruments for use with gas-fired furnaces.

Mechanical Handling

E. Boydell & Co., Ltd. (Stands D611 and 510).—Muir-Hill dumpers, manufactured by this firm, are built to serve the needs of every industry where fast and economical short haulage of bulk materials is an essential prerequisite, such as quarries, chemical works, collieries, public works and building contractors, government and municipal undertakings and improvement schemes. A full range is being exhibited and demonstrated in the exhibition grounds.

Copper Development Association (Stand D230).—This displays some of the more important uses of copper and copper-bearing materials in such recognised fields as electrical and mechanical engineering, chemical engineering and building technique, and in less spectacular but equally interesting manufactures, such as boots and brushes, clock parts and spectacle frames. Information on these and all other uses of copper and copper alloys will be given on request by the technical officers of the association, who will be on duty at the stand throughout the duration of the Fair.

Dunlop Special Products, Ltd. (Stand D220).—The Engineering Components Division is showing a number of working models. One, using cathode-ray oscilloscope equipment, shows anti-vibration mountings for instruments and machinery; another demonstrates the division's flexible barrel coupling for light drives up to 0.31 h.p. per 100 r.p.m. under conditions of severe axial and parallel misalignment; a third, the torsional flexibility of the Disc coupling. The latter model shows a coupling driven through a reduction gear and deflected torsionally by a heavy weight which creates



Powered by a 2 h.p. electric motor, this new mobile compressor set provides a working pressure of 100 p.s.i. and displaces 11 c.f.m. (Hymatic Engineering Co., Ltd.)

conditions of considerable overload and sudden peak loading. This coupling disc consists of a pair of robust steel circular plates with an element of specially compounded rubber bonded between them and its elastic torsional stiffness can be varied over a wide range.

The Hymatic Engineering Co., Ltd. (Stand D105).—Examples of lightweight static, mobile and portable precision-made air compressor sets are being featured, together with accessory equipment and tools. Included are the mobile air compressor set HMS25, a compact and easily transportable power unit. This set, with a petrol engine, has a working pressure of 150 p.s.i. and is powerful enough to operate medium size pneumatic tools or a battery of spray guns. A new mobile compressor set HPS2/T, with petrol engine, and selling at under £70, is also featured. This is suitable for many operations such as crop spraying, disinfestation, powder dusting, tyre inflation and other purposes where small, easily mobile units are required. There is a larger static set, the IS20U, with a three-phase electric motor and with "Perspex" cowl. The sets of which this is an example are enclosed in compact, easy to clean cabinets. They have a displacement of 21.9 cu. ft. per min. and a working pressure of 150 p.s.i. Ancillary equipment includes a new range of pneumatic hammers, kits of tools, spray lances, a new powder duster, spray guns and reducing valves. The Hymatic blow-gun for use with small capacity lightweight equipment to give a jet velocity of 1500 ft. per sec. from standard shop line pressure of 100 p.s.i. is also shown.

G. A. Harvey & Co. (London), Ltd. (Stand B329).—During the past few years this company has added considerably to its

facilities for the fabrication of steel plate. It has contributed to the export drive in the manufacture of plant and equipment for the oil industry and is able now, with one of the most modern plants in the world at their disposal, to undertake the manufacture of pressure vessels, autoclaves, fractionating and absorption towers in steel plate up to 3 in. thickness and of any diameter and length. Representative photographs are shown. Components necessary in the fabrication of high pressure vessels and steel platework generally have for many years occupied the attention of this company, and it is able to supply for the trade a complete range of "Harco" "Rotarprest" ends, dished and flanged ends, channel, angle and flat bar rings. An outstanding exhibit is the range of cold rolled rings, flash butt welded, which are an indication of the type of work produced. There is also shown a range of "Harco" perforated metals in innumerable patterns, for all screening, grading, cleaning, sorting and filtering requirements.

IMPERIAL CHEMICAL INDUSTRIES, LTD. STANDS D315/D212).—The General Chemicals Division of I.C.I. is featuring its metal degreasing service (embracing the use of trichlorethylene, alkalis and emulsions) and its heat-treatment service for molten salt baths. Among the several metal degreasing plants on view are an electrically heated bench model for handling delicate instrument parts, a medium-size plant to work on a single phase a.c. supply, and a totally enclosed continuous plant (with automatic ventilation) for degreasing intricately-shaped articles. All these are installed for normal working on the stand. In addition to featuring the various "Cassel" heat treatment salts and processes, the exhibits include a selection of standard "Cassel" salt bath furnaces of an unusually wide range of sizes (the largest shown has a pot 72 in. deep). Of particular interest is a totally enclosed automatic carburising furnace.

IMPERIAL CHEMICAL INDUSTRIES, LTD., METALS DIVISION (STANDS D409 and 308).—Three main exhibits deal with condenser tubes, aluminium alloys and roofing panels. A model representing the inlet end of a condenser is used to demonstrate some operating conditions which tend to produce failure of condenser tubes through erosion, corrosion or impingement attack. Sections of tubes which have failed in these conditions are also displayed. A second exhibit shows how aluminium alloys can be used in coachbuilding to produce vehicles which are strong, light, durable and an economic proposition. Also featured is an exhibit illustrating the extensive investigation work associated with copper or aluminium alloy-faced roofing panels, and with the adhesives for bonding the layers which make up these units. Their behaviour under rapidly varying temperatures will be shown.

JOHNSON, MATTHEY & CO., LTD. (STAND D100).—A section of this exhibit is devoted to the special products manufactured for the chemical and related industries. The method of presentation is basically photographic, in order that a broad impression of this varied field may be given. To represent the company's activity in the supply of industrial catalysts, a set of large ammonia oxidation units, incorporating rhodium-platinum gauze catalyst nets and a formaldehyde plant which makes use of silver gauze catalyst packs, is shown. The pouring of a batch of optical glass from a platinum-lined crucible is displayed, in indication of the very wide use of the metals as a crucible lining. Chemical process equipment, including plant manufactured in solid silver, vessels lined with the metal and a unit protected by massive silver electrodeposition, is illustrated by photographs and a model.

MUREX, LTD. (STAND 709) is showing in conjunction with its subsidiary companies, Murex Welding Processes, Ltd., which manufacture arce welding equipment and electrodes, and Protolite, Ltd., who distribute "Prolite" hard metal tools, tips and wear-resisting parts. A very wide range of metals, non-ferrous and ferrous alloys and salts of tungsten, molybdenum and vanadium are produced by Murex, Ltd., and a representative collection of these will be on view.

SAUNDERS VALVE CO., LTD. (STAND D129). —Prominent among the models of Safran pumps to be exhibited is the self-contained unishaft electric set. Extremes in the range of sizes, from ¾ in. to 5/6 in., will be emphasised by displaying the smallest model fixed to the flange of the largest. A medium size model (1½ in./2 in.) will be demonstrating "good delivery" by continuous, rock-steady running, and a fourth example will indicate its suitability for fixing in any position. For operation in remote situations there are petrol, paraffin and diesel-engined pumps again available as self-contained (unishaft and uni-built) sets of compact, rigid assembly and also as heavier direct-coupled units with sturdy bedplates and flexible couplings.

STEEL & CO., LTD. (STANDS B617 and D Outdoor.—Steel & Company, Ltd., designers and manufacturers of mechanical handling plant and equipment, is showing

(Continued at foot of next page)

Promoting Textile Technology

Growing Support and Activity of the Textile Institute

THE growth and virility of the Textile Institute were recorded in the report of the council presented at the annual meeting held at Preston on April 27.

The report frankly acknowledges that numbers are not the only criterion of success, which must also be dependent on action and usefulness. It notes, however, the healthy interest in the activities of the Institute shown by the average increase of nearly 60 new members each month. Membership rose to 4351, a net gain of 623, after allowing for deaths, resignations, etc.

Information and Education

The importance of conferences was emphasised, as by this means it was possible for the practical man of experience to share his accumulated knowledge to the benefit of others, and by discussion to find ways of overcoming difficult problems.

During 1948 over one hundred meetings had been held by the Institute's 13 sections and branches, and productivity had been shown to be the industry's main concern.

In education it was shown that an increasing number of young men and women entering the industry were making the A.T.I. their ultimate target. Applications for the Institute's diplomas in 1948 had totalled 291, nearly twice as many as in any previous year. Since the Royal Charter had been received in 1925, there had been 2194 applications made, and 1308 diplomas had been granted.

A great deal of encouragement by means of awards and competitions had been given to students, and the number of candidates for National Certificates in Textiles continued to rise. Since the inception of the scheme in 1935, there had been 519 Higher and 1019 Ordinary National certificates awarded.

Considerable work had been achieved in standardisation. The importance of representation on the British Standard Institution's committees dealing with textiles was revealed by the need to obviate the placing of demands on the industry which could not be met.

New handbooks on textile technology and the Institute's first Year Book had been published, while plans were in hand, in co-operation with the Society of Dyers and Colourists, for an annual review of textile progress, the first issue of which was expected in 1950.

The necessity for wider public relations for textiles had been recognised by closer association with Public Relations Officers, libraries, students, youth employment officers, etc. While as a result of the Institute's representations the Ministry of Labour and National Service had undertaken to include a booklet on textiles in the series "Choice of Careers."

Expenditure had again exceeded income in 1948, but this deficiency (met from the Development Fund), was due to a policy of expansion and development intended to cover a period of years.

Fewer Retreads.—Production of retreads in 1948 by members of the Retread Manufacturers' Association again topped the million mark—1,171,790. This is 29,916 short of the record set up in 1947. Car sizes numbering 757,999 were 133,931 fewer than in 1947.

B.I.F. REVIEW

(Continued from previous page)

its electric hoist blocks. Particularly interesting is the working model of the gears of this lifting unit. Visitors will be able to examine the careful manner in which complete enclosure of all working parts has been obtained, and the strength and efficiency achieved. Also showing are the latest "electric eel" industrial trucks. The three models on show are the 30-cwt. Loadcarrier, the 50-cwt. Low-lift and the Tractor. At Stand D Outdoor is shown a range of Mobile cranes, including the 12½ ton model now in use by numerous construction companies.

THOS. W. WARD, LTD., AND SUBSIDIARY COMPANIES (STANDS D745 and D Outdoor).—The subsidiary companies represented are: Darlington Railway Plant & Foundry Co., Ltd., railway track specialities; Widnes Foundry & Engineering Co., Ltd., specialised castings and fabricated vessels for the chemical, gas, oil and allied industries; Geo. Cooper & Sons, nuts, bolts, light forgings; Lowmoor Best Yorkshire Iron, Ltd., wrought iron sections, plates and special forgings; Silent Machine & Engineering Co., Ltd., food preparing machinery; John Smith (Keighley), Ltd., overhead travelling cranes, derricks, etc., stone working machinery. Other members of the group have separate stands, notably Thos. Smith & Sons (Rodley), Ltd., Marshall Sons & Co., Ltd., Marshall Richards Machine Co., Ltd.

Personal

THE Honorary Fellowship of the Textile Institute, the highest award the institute can bestow—there have been only eight previous recipients—is to be conferred on DR. D. A. CLIBBENS, of the British Cotton Industry Research Association. This is to recognise his work on the chemistry of cellulose and the development of analytical and testing methods for the control of bleaching, mercerising and dyeing. He evolved a precise test for the factory control of operations in which fabrics are easily damaged, and has seen it adopted in every part of the world where cotton and linen fabrics are finished.

A former colleague of Dr. Clibbens at the BCIRA, DR. S. A. SHORTER, is to receive the Warner Memorial Medal, in recognition of original investigation, the results of which have been published in the institute's *Journal*. Dr. Clibbens was a recipient of the Warner Medal in 1947.

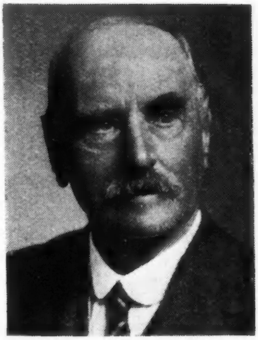
The University of Pennsylvania Press has announced the appointment of MR. HENRY M. LEICESTER, professor of biochemistry, College of Physicians and Surgeons in San Francisco, as editor-in-chief of *Chymia: Annual Studies in the History of Chemistry*. Dr. Leicester is chairman of the History of Chemistry Division, American Chemical Society, and associate editor of the *Journal of Chemical Education*. PROF. JOHN READ, professor of chemistry and director of the Chemistry Research Laboratory, University of St. Andrews, is the new associate editor of *Chymia*.

MR. J. STANLEIGH TURNER has resigned the deputy chairmanship of the East Midlands division of the National Coal Board, to which he was appointed in September, 1946. He will remain a part-time director. Mr. Turner is this year's president of the Coal Utilisation Joint Council, of which he was one of the first members.

MR. WILLIAM JONES, of Hafod, Ruthin, a wartime coal controller for Wales, has been appointed a part-time member of the South-Western Divisional Coal Board operating the South Wales coalfield. He is already a part-time director of the Wales Gas Board.

MR. P. A BERRY, works director of Felton, Grimwade & Duerdins, Pty., Ltd., has been appointed a director of Drug Houses of Australia, Ltd., in place of MR. W. RUSSELL GRIMWADE who has resigned.

Obituary



Sir Wyndham Dunstan

The death was reported last week of SIR WYNDHAM DUNSTAN, distinguished chemist and scientist, whose services to the Imperial Institute, which he directed for over 20 years, were in a large measure responsible for the active and enterprising character of the present organisation. Sir Wyndham Dunstan was born in 1861, educated at Bedford School, and became University lecturer in chemistry in its relation to medicine at Oxford in 1885.

He joined the Pharmaceutical Society as Professor of Chemistry and later occupied the chair of Professor of Chemistry at St. Thomas's Hospital from 1892-1900.

For many years he took an active interest in the Chemical Society of which he was secretary from 1893-1903, and vice-president for the following three years. He was elected a Fellow of the Royal Society early in his career and served as a member of the council during 1905-1907.

During his 30 years' association with the Imperial Institute, of which he was director (in succession to the late Sir Frederick Abel), from 1903 to 1924, Sir Wyndham Dunstan was largely responsible for making the institute the chief centre of scientific and technical information on the economic resources of the British Commonwealth. Under his guidance the laboratory work was greatly increased, while it was through his initiative that the reorganisation and development of the public galleries took place, with their collections of products of all countries of the Commonwealth.

With an enthusiastic staff, Sir Wyndham

(*Continued at foot of next page*)

Next Week's Events

MONDAY, MAY 2

British Industries Fair.—Opening of the 28th Fair at Earls Court and Olympia, London, and at Castle Bromwich, Birmingham.

Society of Chemical Industry. London: London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, 6.30 p.m. Annual general meeting. Dr. M. P. Balfe: "Leather: The Scientific Background to a Traditional Industry."

TUESDAY, MAY 3

Institution of Works Managers. Sheffield: Royal Victoria Station Hotel, 7 p.m. D. F. Evans-Hemming: "Personnel Administration."

Electrodepositors' Technical Society (Midlands Centre). Birmingham: James Watt Memorial Institute, Great Charles Street, 6.30 p.m. W. F. Brettell: "Ventilation and Exhausting Systems."

Council of Industrial Design. London: Murray House, Petty France, S.W.1. Jointly with the Institute of Packaging and the Printing, Packaging, and Allied Trades Research Association. Exhibition of flexible commercial packs and packaging materials, until May 31.

WEDNESDAY, MAY 4

British Association for Commercial and Industrial Education. Manchester: One-day conference.

Society of Public Analysts and Other Analytical Chemists. London: 26 Portland Place, W.1, 7 p.m. W. B. Emery and A. D. Walker: "The Colorimetic Determination of Streptomycin B (Mannosidostreptomycin)": H. G. Rees and P. O. Dennis: "Chemical Determination of Nicotinic Acid in Food Products"; H. Holness: "Reduction of Antimonial Tin Solutions with Metallic Nickel and Cobalt."

THURSDAY, MAY 5

The Chemical Society. North Wales: Bangor, University College of North Wales, 5.30 p.m. Joint meeting with University College of North Wales Chemical Society. Prof. E. L. Hirst: Lecture.

British Institution of Radio Engineers. Manchester: Reynolds Hall, College of Technology, 6.45 p.m. W. G. Roberts: "Ceramic Capacitors."

Pharmaceutical Society. Manchester: Council Chamber, Houldsworth Hall, 7.45 p.m. Junior branch: annual general meeting.

Leeds Metallurgical Society. Leeds: University, 7 p.m. Annual general meeting and students' papers.

FRIDAY, MAY 6

Society of Chemical Industry. Birmingham: University, Edmund Street, 6.30 p.m. Annual election and business meeting.

Association of Special Libraries and Information Bureaux (Northern Branch). Edinburgh: The Royal Society of Edinburgh, George Street. One-day conference and discussion. Speakers include: P. W. Thomas on "The Problems of the Technical Society Library."

Royal Statistical Society (Industrial Applications Section). London: Elma Lighting Service Bureau, Savoy Hill, W.C.2. Forum. Prof. E. S. Pearson, Dr. B. P. Dudding, Phillip Lyle, and E. C. Fieller; chairman: D. Newman.

OBITUARY

(Continued from previous page)

Dunstan did much to expand and develop overseas industries connected with cotton, rubber, cocoa, vegetable oils, fibres, tanning materials, timber, drugs, tobacco, etc. After his early investigations on the quality of Indian coal (1898), he suggested the establishment of colonial mineral surveys in Nigeria, Nyasaland, and Ceylon, which were carried out under the auspices of the Imperial Institute, and which laid the foundations of the present colonial geological surveys.

Dr. Albert Mylius, president of J. R. Geigy, Ltd., Basle, died on April 10, after a short illness. He was for 50 years intimately connected with the company's expansion, both in Switzerland and abroad.

Dr. Walter Gygax, deputy-director of the Dr. A. Wander, A.G., Berne, died on Good Friday. He had been on the staff of the Swiss company for almost three decades.

Good Relations

Mr. Walter Nellies, veteran secretary of the National Union of Shale Miners and Oil Workers, in his last report compliments the management of Scottish Oils, Ltd., and especially Mr. Robert Crichton, managing director. Mr. Nellies, who has retired after 30 years' service to the union, records that he has found the management always prepared to meet union demands if it could do so, and that co-operation spread throughout the organisation. The new secretary of the union is Mr. James M'Kelvie.

Home News Items

Guerdon of Gold.—An allocation of gold has been made to allow each of more than 100 employees of the Dunlop Rubber Company with 30 years' service to receive a gold badge.

Physical Laboratory Visit.—An "open day" is to be held on May 26 from 2.30—6 p.m. by the National Physical Laboratory, Teddington, to give industrial organisations a chance to see the wide range of scientific research and investigation undertaken. Applications should reach the director not later than May 14.

Scottish Ceramics.—Production in the ceramics industry in Scotland is reported to be severely limited by the deferment of new construction. Some sections have been obliged to reduce output, pending the full revival of constructional work. One interesting development is the plan to introduce electric furnaces to the Highlands so that local clay deposits can be investigated.

Record Whale Catch.—The 90 British members of the 500 crew of the 15,000-ton whale factory ship *Balaena* were paid off in Liverpool last week with the highest pay packets of any employed in the vast Antarctic fleet. None received less than £400. The *Balaena's* catcher fleet caught 2500 blue and sperm whales, yielding 196,400 barrels of oil (32,753 tons). This is the season's record and the three other British factory vessels operating in the Antarctic had totals almost as large.

Paper Firm's Plans.—Schemes for the greater diversification of business were mentioned by Sir Eric Bowater in his address at the annual general meeting of the Bowater Paper Corporation. Negotiations were in progress, he said, with an American concern for production in this country of other processed paper products, but authority still had to be obtained. If arrangements were satisfactory it was intended to erect the necessary factory in one of the development areas.

Coal Production.—Official figures relating to coal production in Britain in the week ending April 16, which included Good Friday, show that the total output of 3,912,800 tons was some 131,000 tons higher than in the comparable Good Friday week of 1948. Total output for the year to April 16 was 63,782,300 tons (deep-mined 60.545 million tons, opencast 3,237,300 tons), compared with the total for the first 15 weeks of 1948, 60,883,200 tons (deep-mined 57,718,100 tons, opencast 3,165,100).

Savings Record.—National Savings by employees of the Dunlop Rubber Company at Fort Dunlop have set up a record in the first quarter of this year. The total, £25,190 is £5000 more than last year and much higher than in any of the war years.

KID Exemption.—The Treasury has made an order under Section 10(5) of the Finance Act, 1926, exempting 2-ethyl hexoic acid and calcium-ortho-iodoxybenzoate from Key Industry Duty for the period April 14, until June 30. The Order is "The Safeguarding of Industries (Exemption) (No. 2) Order, 1949," and is published as Statutory Instruments, 1949, No. 696.

Change of Address.—To keep in closer touch with work and stocks. Reed Brothers (Engineering), Ltd., has increased the office accommodation at its Millwall works so that all staff will be under one roof. From April 25 all communications should be addressed to: Replant Works, Cuba Street, Millwall, London, E.14 (telephone: EAST 4081/5).

Paper, Printing, and Ink Symposium.—Developments in paper, printing methods, and printing inks are to be the subject of a symposium to be held by the technical training scheme for the printing ink industry on Saturday May 14, at 10.30 a.m., at the Royal Institution, Albemarle Street, London, W.1. Speakers in the three industries will be R. F. Bowles, R. B. Fishenden, and Dr. Julius Grant.

More Nylon Polymer.—The new nylon plant about to come into operation at the Billingham-on-Tees works of Imperial Chemical Industries, Ltd., will produce at the outset 5000 tons of nylon polymer annually. When working at full production about 550 people will be employed. The bulk of the output will go to British Nylon Spinners and the rest will be transferred to the I.C.I. plastics factory where it will be converted into various grades of monofilaments.

SCI Meeting.—A varied programme of lectures, tours, and social events has been arranged for the 68th annual meeting of the Society of Chemical Industry to be held in Manchester from July 11-15. Principal items of the first two days will be the reception by the chairman of the Manchester section, and the presidential address. On July 13 the Society's medal will be presented to Foster D. Snell, who will give an address. The Ivan Levinstein Memorial Lecture is to be delivered by P. Karrer on July 14.

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

Satisfaction

Adam Hilger, Ltd., London, E.C. (M.S., 30/4/49.) Satisfaction, March 14, of mortgage and charge registered November 9, 1945.

Company News

The name of **Alkyl Aryl Chemicals, Ltd.,** 85 Gracechurch Street, E.C.3, has been changed to **Alkyl Aryl Products, Ltd.**

F. W. Berk & Co., Ltd., on April 28, offered for sale 200,000 4½ per cent cumulative preference shares of £1 each at 21s. and 240,000 ordinary shares of 2s. 6d. at 15s. 3d. Issued capital consists of 200,000 preference and 800,000 ordinary shares. Profits of the company and its subsidiaries in 1948 amounted to £94,768.

The Distiller's Co., Ltd. The directors have declared a dividend on the preference stock for the six months ended March 31, 1949, of three per cent less tax, payable on May 14.

New Companies Registered

Autosan Products, Ltd. (467,214). Private company. Capital £10,000. Manufacturers of chemicals, solvents, drugs, oils, etc. Directors: E. Hopkins, Col. Wm. B. J. O. Mitford, C. Macdonald. Reg. office: 9a Craven Hill, W.2.

Deainit Co., Ltd. (467,226). Private company. Capital £100. Manufacturers of cleansing materials, chemicals, fertilisers, etc. Directors: J. Watson, H. E. Senior. Reg. office: 21 Ely Place, E.C.1.

Delmarco, Ltd. (467,327). Private company. Capital £3,000. Objects: To acquire the business of detergent and manufacturers' agents carried on as "Delmarco Company" at 367 Wigan Road, Leigh, Lancs. Directors: D. Jones, Wm. McConville, E. V. Cooper, A. S. Knowles, F. Bamford. 53 Railway Road, Leigh, Lancs.

Irish Herbals (Herbalists and Growers), Ltd. (12,836). Private company. Capital £5,000. Manufacturers of herbs, acids, etc. Subscribers: H. J. W. Downey, R. V. H. Downey, 118 Grafton St., Dublin.

Leopold Weis (Oils and Oil Seeds), Ltd. (467,157). Private company. Capital £10,000. Objects: To acquire the business of an oil and oil seed broker now carried on by L. Weis at 24 St. Mary Axe, E.C.3. Directors: L. Weis, Mrs. M. A. Weis, Miss E. E. Hack. Sol: Waltons and Co., 101 Leadenhall St., E.C.3.

Orbro Products, Ltd. (467,360) Private company. Capital £100. Manufacturers of soap, oils, etc. Directors: F. Hornett, E. E. Hornett, Registered office: Manor Way Farm, Gooseley Lane, Barking Bye-Pass Road, Barking.

Chemical and Allied Stocks and Shares

THE better tendency which was developing in stock markets was checked by the Chinese news, buyers showing caution and prices in all sections losing part of earlier gains. British Funds remained active and were again higher on balance in anticipation of the British Gas stock terms and the pending initial business in this latest nationalisation security.

There has been no large-scale switching from shares of gas companies into industrial and other shares to escape the exchange into Gas stock. But the market believes that investors will realise more widely the extent to which the exchange into Gas stock will reduce their income and that there may therefore be a good deal of selling.

Before receding with the general trend of markets, industrial shares were stimulated by the record Imperial Chemical results. The jump of over £3 millions in net profits—from £7,646,933 to £10,850,414—exceeded best expectations and the shares have responded with a jump to 46s. 7½d., at which there is a yield of 4⅜ per cent. Judging from the preliminary figures, it would appear that nearly 30 per cent has been earned on the ordinary shares, and it seems certain the company will derive much fuller benefit this year from the new capital raised in 1948.

Monsanto Chemical remained under the influence of the report and accounts and changed hands around 57s. 6d. Elsewhere, Fisons were 50s. 9d. and Burt Boulton & Haywood 27s. 6d. Albright & Wilson have been firm at 30s. 3d., Brotherton 10s. shares strengthened to 20s. 7½d., Bowman Chemicals 4s. shares were 7s., Boake Roberts 5s.

ordinary 30s. 6d. and Amber Chemical 2s. shares changed hands around 7s. British Glues & Chemicals 4s. shares have been firm at 18s. and William Blythe 3s. shares transferred up to 21s. 9d. Among preference shares, W. J. Bush 5 per cents were 25s., L. B. Holliday 4½ per cents 22s. 4½d. and British Chemicals and Biologicals 4 per cents 20s. 9d.

British Aluminium have been steady at 45s. 3d. on the statements at the meeting, United Molasses eased to 47s. prior to the dividend announcement, the units of the Distillers Co. at 27s. 6d. remained firm and Borax Consolidated have been steady at 53s.

Shares of companies with plastics interests were again easier, particularly Kleeman at 14s. 4½d., awaiting the interim dividend news. British Xylonite came back to 96s. 3d. after an earlier rally, De La Rue were 37s. and British Industrial Plastics 2s. shares steady at 6s.

Associated Cement have eased slightly to 81s. 6d. The company's results will be issued slightly later on this occasion because of the longer time taken to prepare the first consolidated accounts for the group. The circularisation of shareholders by the company will bring in the support of shareholders in opposing nationalisation of the cement industry. Other cement shares were firm with British Portland at 90s. 7½d., Tunnel Cement 47s. 6d. and Rugby Cement 37s. 9d. Elsewhere, British Plaster Board were 22s. 10½

Iron and steels have been well maintained, and in other directions, Babcock & Wilcox firmed up to 67s. 6d. in anticipation of good results. Tube Investments strengthened to close on £6¾, and General Refractories held their recent improvement to 24s. 6d.

Boots Drug at 53s. 9d. were little changed on balance, Beechams deferred were 16s. and Sangers 32s. 1½d. Glaxo Laboratories were prominent among shares considered in the market to offer future bonus prospects, but at £23 held only part of an earlier rise. British Drug Houses 5s. shares have changed hands around 7s. 9d.

Oils receded, Anglo-Iranian to £8 1/32, while Shell were 66s. 3d. and Burmah Oil 65s. 3d.

Canadian Profits Reduced.—A drop in operating and net profits for both the February quarter and first six months of the company's fiscal year (since September 30) is reported by Canadian Industrial Alcohol Co., Ltd., and subsidiaries. For the six-month period operating profits were $1,169,774 against $1,690,650 a year ago and total income was $1,296,358 compared with $1,942,864.

RISING SCALE OF JAPANESE DYESTUFFS

JAPAN'S dyestuffs manufacturing capacity, now aggregating 11,770 tons annually, may be increased under the five-year plan to 28,500 tons by the end of the fiscal year 1953. The news has called to mind the very rapid expansion of Japan's dyestuff industry in the inter-war period when large quantities were shipped to China and other Asiatic markets by the Mitsui Bussan Company. The strength of this subsidiary of the Mitsui Empire was reflected by the fact that even I.G. Farbenindustrie, the world's leading pre-war dyestuff exporter, found it difficult to sell its products in markets served by the Japanese.

During the war period, Japan's dyestuff output aggregated roughly 7000 tons a year, equal to about one-tenth of the pre-war figure.

The immediate post-war period imposed great difficulties. In addition to the general uncertainty as to the country's status in world markets, dyestuff production was much hampered by the coal shortage and by the lack of other basic products. However, the fairly rapid rehabilitation of her textile manufacturing industries encouraged a revival of dyestuffs manufacturing, and output for the fiscal year 1948 is estimated to have amounted to roughly 7500 tons, a large part of which was destined for export.

More Lancashire Steel ?

The view that Merseyside's unemployment problem could be eased if Lancashire steel output were considerably greater was expressed by Mr. John E. James, chairman of the Lancashire Steel Corporation, when he opened the British Iron and Steel Federation's exhibition in Manchester, on April 20. Explaining that the establishment of greater steel-producing capacity in the area between Manchester and Liverpool would stimulate the setting up on Merseyside of industries concerned with processing of raw materials, he said: "On Merseyside there is an abundance of good, hard, intelligent labour waiting to be taken up. The day will come when Lancashire will produce enough steel for it to be taken up." Instead of the 500,000 tons at present being produced annually in the area, Lancashire steel output should be at least 1 million tons because of its large internal demand. He forecast revolutionary changes in methods of steel production in the next few years which would enable the output of steelworks to be stepped up by at least 33⅓ per cent.

Prices of British Chemical Products

THE industrial chemicals market has lost no time in resuming fully active trading conditions and delivery specifications from the chief consuming industries have covered good volumes. New business is reported to be on a satisfactory scale and the flow of inquiries for shipment appears to be undiminished. There have been no important price changes and quotations, on the whole, remain steady. Formaldehyde, hydrogen peroxide and arsenic have been in good request and a brisk inquiry for fertilisers is reported. Items for which there is a persistent demand include chlorate of soda and barium chloride and the firm undertone continues for practically the whole range of the potash chemicals. There has been a steady call for the lead oxides and also for zinc compounds. There is nothing of particular interest to report on the coal tar products market, where quotations remain unchanged.

MANCHESTER.—From the point of view of new business, fairly active trading conditions have been apparent during the past week on the chemical market here. Home-trade buying of the soda compounds and other leading heavy products has been on steady lines and a fair amount of additional business has been booked for shipment overseas. Meanwhile, the movement of supplies into actual consumption against existing orders has been on a satisfactory scale, especially to the cotton and wool textile and allied industries. In the fertiliser market there is a continued brisk call for superphosphates, as well as for the nitrogenous fertilisers and the compounds. Conditions affecting the tar products have been patchy, with the light distillates attracting most attention from buyers.

GLASGOW.—Business in the Scottish chemical market during the past week has generally shown a slight improvement, although the earlier part of the week showed the reaction of the Easter holidays. There are several instances of reduced prices operating. The export market continues to show a fairly active flow of inquiries. Prices are still proving competitive and a number of orders are being received.

Price Changes

Rises: Ammonium carbonate, pyridine.

Reductions: Ammonium bicarbonate, red lead, orange lead, white lead, litharge, zinc oxide, zinc sulphate.

General Chemicals

Acetic Acid.—Maximum prices per ton: 80% technical, 1 ton, £64; 80% pure, 1 ton, £66; commercial glacial 1 ton £79; delivered buyers' premises in returnable barrels: £4 10s. per ton extra; in glass carboys, £7; demijohns, £11.

Acetic Anhydride.—Ton lots, d/d, 11¾d. per lb.

Acetone.—Small lots: 5 gal. drums, £90 per ton; 10 gal. drums, £85 per ton. In 40/45 gal. drums less than 1 ton, £70 per ton; 1 to 9 tons, £69 per ton; 10 to 50 tons, £68 per ton; 50 tons and over £67 per ton.

Alcohol, Industrial Absolute.—50,000 gal. lots, d/d, 2s. 7⅞d. per proof gallon; 5000 gal. lots, d/d, 2s. 10⅞d. per proof gal.

Alcohol, diacetone.—Small lots: 5 gal. drums, £133 per ton; 10 gal. drums, £128 per ton. In 40/45 gal. drums: less than 1 ton, £113 per ton; 1 to 9 tons, £112 per ton; 10 to 50 tons, £111 per ton; 50 to 100 tons, £110 per ton; 100 tons and over, £109 per ton.

Alum.—Loose lump, £17 per ton, f.o.r. MANCHESTER: Ground, £17 10s.

Aluminium Sulphate.—Ex works, £11 10s. per ton d/d. MANCHESTER: £11 10s.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Bicarbonate.—2 cwt. non-returnable drums; 1 ton lots, £40 per ton.

Ammonium Carbonate.—1 ton lots: lump £52 10s., ground £55 10s. per ton d/d in 5-cwt. casks. MANCHESTER: Powder, £50 d/d.

Ammonium Chloride. — Grey galvanising, £22 10s. per ton, in casks, ex wharf. Fine white 98%, £21 to £25 per ton. See also Salammoniac.

Ammonium Nitrate.—D/d, £18 to £20 per ton.

Ammonium Persulphate.—MANCHESTER: £5 per cwt. d/d.

Ammonium Phosphate.—Mono- and di-, ton lots, d/d, £78 and £76 10s. per ton.

Antimony Oxide.—£162 10s. per ton.

Antimony Sulphide.—Golden, d/d, as to quantity, etc., 4s. to 5s. per lb.

Arsenic.—Per ton, £40 5s. to £41 5s., according to quality, ex store.

Barium Carbonate.—Precip., d/d; 2-ton lots, £25 15s. per ton, bag packing, ex works.

Barium Chloride.—£35 to £35 10s. per ton.

Barium Sulphate (Dry Blanc Fixe).—Precip., 4-ton lots, £26 10s. per ton d/d; 2-ton lots, £26 15s. per ton.

Bleaching Powder. Spot, 35/37%, £18 10s. per ton in casks (1 ton lots).

Borax.—Per ton for ton lots, in free 1-cwt. bags, carriage paid: Commercial, granulated, £28; powdered, £30 10s. to £31 10s.; extra fine powder, £32 10s. B.P., crystals, £39; powdered, £39 10s.; extra fine, £40 10s. Borax glass, per ton in free 1-cwt. waterproof paper-lined bags, for home trade only, carriage paid: lump, £77; powdered, £78.

Boric Acid.—Per ton for ton lots in free 1-cwt. bags, carriage paid: Commercial, granulated, £48; crystals, £53; powdered, £51-£53; extra fine powder, £56. B.P., crystals, £61; powder, £62; extra fine, £64.

Calcium Bisulphide.—£6 10s. to £7 10s. per ton f.o.r. London.

Calcium Chloride.—70/72% solid, £8 12s. 6d. per ton, in 4 ton lots.

Charcoal, Lump.—£25 per ton, ex wharf. Granulated, £30 per ton.

Chlorine, Liquid.—£28 per ton d/d in 16/17-cwt. drums (3-drum lots).

Chrometan.—Crystals, 5⅝d. per lb.

Chromic Acid.—1s. 10d. to 1s. 11d. per lb., less 2½%, d/d U.K.

Citric Acid.—Controlled prices per lb., d/d buyers' premises. For 5 cwt. or over, anhydrous, 1s. 6¾d., other, 1s. 5.; 1 to 5 cwt., anhydrous, 1s. 9d., other, 1s. 7d. Higher prices for smaller quantities.

Cobalt Oxide.—Black, delivered, 7s. 7½d. per lb.

Copper Carbonate.—MANCHESTER: 1s. 6½d. per lb.

Copper Chloride.—(53 per cent), d/d, 1s. 10½d. per lb.

Copper Oxide. — Black, powdered, about 1s. 4½d. per lb.

Copper Nitrate.—(53 per cent), d/d, 1s. 8½d. per lb.

Copper Sulphate.—£42 10s. per ton f.o.b., less 2%, in 2-cwt. bags.

Cream of Tartar.—100%, per cwt., about £7 8s. per 1-2 cwt. lot, d/d.

Ethyl Acetate.—10 tons and upwards, d/d, £115 per ton.

Formaldehyde.—£31 per ton in casks, according to quantity, d/d. MANCHESTER: £32.

Formic Acid.—85%, £64 per ton for ton lots, carriage paid. 90%, £67 5s. per ton.

Glycerine.—Chemically pure, double distilled 1260 s.g. £123 per cwt. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

Hydrochloric Acid.—Spot, 7s. 6d to 8s 9d per carboy d/d, according to purity strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Hydrogen Peroxide.—1s. 0½d. per lb. d/d, carboys extra and returnable.

Iodine.—Resublimed B.P., 10s. 4d. to 14s. 6d per lb., according to quantity.

Iron Sulphate.—F.o.r. works, £3 15s. to £4 per ton.

Lactic Acid.—Pale, tech., £80 per ton; dark tech., £70 per ton ex works; barrels returnable.

Lead Acetate.—White, 120s. to 122s. per cwt

Lead Carbonate.—British dry, ton lots, d/d, £131 per ton.

Lead Nitrate.—About £116 per ton d/d in casks. MANCHESTER: £115.

Lead, Red.—Basic prices per ton: Genuine dry red lead, £121 10s.; orange lead, £133 10s. Ground in oil: red, £145 10s.; orange, £167 10s. Ready-mixed lead paint: red, lots of 20 gals. and under 160 gals. in 1 gal. tins uncrated, £2 6s. 6d. per gal.; orange, 3s. 6d. per gal. extra over the price for red.

Lead, White.—Dry English, in 8-cwt. casks, £131 per ton. Ground in oil, English, 50-100 tons lots, £144 per ton.

Lime Acetate.—Brown, ton lots, d/d, £18 to £20 per ton; grey, 80-82 per cent, ton lots, d/d, £22 to £25 per ton.

Litharge.—£121 10s. per ton.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcined, in bags, ex works, £18 5s.

Magnesium Carbonate.—Light, commercial, d/d, £70 per ton.

Magnesium Chloride.—Solid (ex wharf), £27 10s. per ton.

Magnesium Oxide.—Light, commercial, d/d. £160 per ton.

Magnesium Sulphate.—£12 to £14 per ton.

Mercuric Chloride.—Per lb., lump, 7s. 4d.; smaller quantities dearer.

Mercurous Chloride.—8s. to 9s. per lb., according to quantity.

Mercury Sulphide, Red.—Per lb., from 10s. 3d. for ton lots and over to 10s. 7d. for lots of 7 to under 30 lb.

Methanol.—Pure synthetic, d/d, £28 to £38 per ton.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 4s. 8d. per gal.; pyridinised 64° O.P. 100 gal., 4s. 11d. per gal.

Nickel Sulphate.—F.o.r. works, 3s. 4d. per lb.

Nitric Acid.—£24 to £26 per ton, ex works.

Oxalic Acid.—£128 to £133 per ton packed in free 5-cwt. casks.

Paraffin Wax.—Nominal.

Phosphoric Acid.—Technical (S.G. 1.500), ton lots, carriage paid, £61 per ton; B.P. (S.G.1.750), ton lots, carriage paid, 1s. 1d. per lb.

Phosphorus.—Red, 3s. per lb. d/d; yellow, 1s. 10d. per lb. d/d.

Potash, Caustic.—Solid, £65 10s. per ton for 1-ton lots; flake, £76 per ton for 1-ton lots. Liquid, d/d, nominal.

Potassium Bichromate. — Crystals and granular, 9⅝d. per lb.; ground, 10⅝d. per lb., for not less than 6 cwt.; 1-cwt. lots, ½d. per lb. extra.

Potassium Carbonate.—Calcined, 98/100%, £64 per ton for 1-ton lots, ex store; hydrated, £58 for 1-ton lots.

Potassium Chlorate.—Imported powder and crystals, nominal.

Potassium Chloride.—Industrial, 96 per cent, 6-ton lots, £16.10 per ton.

Potassium Iodide.—B.P., 11s. 1d. to 12s. per lb., according to quantity.

Potassium Nitrate.—Small granular crystals, 76s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 8½d. per lb. for 1-cwt. lots; for 3 cwt. and upwards, 1s. 8d. per lb.; technical, £7 14s. 3d. to £8 6s. 3d. per cwt., according to quantity d/d.

Potassium Prussiate.—Yellow, nominal.

Salammoniac.—First lump, spot, £48 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £21 to £25 per ton, in casks, ex store.

Salicylic Acid.—MANCHESTER: 1s. 11d. to 3s. 1d. per lb. d/d.

Soda Ash.—58° ex depôt or d/d, London station, £7 12s. 6d. to £8 7s. 6d. per ton.

Soda, Caustic. — Solid 76/77%; spot, £19 per ton d/d.

Sodium Acetate.—£41-£55 per ton.

Sodium Bicarbonate.—Refined, spot, £11 10s. per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 8d. per lb.; anhydrous, 7½d. per lb., net, d/d U.K. in 7-8 cwt. casks.

Sodium Bisulphite. — Powder, 60/62%, £28 7s. 6d. per ton d/d in 2 ton lots for home trade.

Sodium Carbonate Monohydrate.—£25 per ton d/d in minimum ton lots in 2-cwt. free bags.

Sodium Chlorate.—£52 to £57 per ton.

Sodium Cyanide.—100 per cent basis, 8d. to 9d. per lb.

Sodium Fluoride.—D/d, £4 10s. per cwt.

Sodium Hyposulphite.—Pea crystals 22s. 6d. per cwt. (2-ton lots); commercial, 1-ton lots, £16 per ton carriage paid. Packing free.

Sodium Iodide.—B.P., 10s. 2d. per lb. to 12s. 1d. according to quantity.

Sodium Metaphosphate (Calgon).—Flaked loose in metal drums, £103 ton.

Sodium Metasilicate.—£19 to £19 5s. per ton, d/d U.K. in ton lots.

Sodium Nitrate.—Chilean Industrial, 97-98 per cent, 6-ton lots, d/d station, £20 10s. per ton.

Sodium Nitrite.—£29 10s. per ton.

Sodium Percarbonate.—12½% available oxygen, £7 per cwt. in 1-cwt. drums.

Sodium Phosphate.—Di-sodium, £32 10s. per ton d/d for ton lots. Tri-sodium, £62 per ton d/d for ton lots.

Sodium Prussiate.—9d. to 9½d. per lb. ex store.

Sodium Silicate.—£6 to £11 per ton.

Sodium Silicofluoride.—Ex store, nominal.

Sodium Sulphate (Glauber Salt).—£8 per ton d/d.

Sodium Sulphate (Salt Cake).—Unground. £6 per ton d/d station in bulk. MANCHESTER: £6 5s. per ton d/d station.

Sodium Sulphide. — Solid, 60/62%, spot. £23 per ton, d/d, in drums; broken, £23 15s. per ton, d/d, in casks.

Sodium Sulphite.—Anhydrous, £29 10s. per ton; pea crystals, £20 10s. per ton d/d station in kegs; commercial, £12 to £14 per ton d/d station in bags.

Sulphur.—Per ton for 4 tons or more, ground, £14 12s. 6d. to £16 17s. 6d., according to fineness.

Sulphuric Acid.—168° Tw., £6 10s. to £7 10s. per ton; 140° Tw., arsenic free £5 2s. 6d. per ton; 140° Tw., arsenious, £4 15s. per ton. Quotations naked at sellers' works.

Tartaric Acid.—Per cwt: 10 cwt. or more £9; 5 to 9 cwt. £9 2s.; 2 to 4 cwt. £9 4s.; 1 cwt. £9 6s.

Tin Oxide.—1-cwt. lots d/d £25 10s.

Titanium Oxide.—Comm., ton lots, d/d, (56 lb. bags), £102 per ton.

Zinc Oxide.—Maximum prices per ton for 2-ton lots, d/d; white seal, £97 15s.; green seal, £96 15s.; red seal, £95 5s.

Zinc Sulphate.—£31 per ton.

Rubber Chemicals

Antimony Sulphide.—Golden, 4s. to 5s. per lb. Crimson, 2s. 7½d. to 3s. per lb.

Arsenic Sulphide.—Yellow, 1s. 9d. per lb.

Barytes.—Best white bleached. £8 3s. 6d. per ton.

Cadmium Sulphide.—6s. to 6s. 6d. per lb.

Carbon Bisulphide.—£37 to £41 per ton, according to quality, in free returnable drums.

Carbon Black.—6d. to 8d. per lb., according to packing.

Carbon Tetrachloride.—£56 to £59 per ton, according to quantity.

Chromium Oxide.—Green, 2s. per lb.

India-rubber Substitutes.—White, 10 5/16d. to 1s. 5¾d. per lb.; dark, 10¼d. to 1s. per lb.

Lithopone.—30%, £36 15s. per ton.

Mineral Black.—£7 10s. to £10 per ton.

Mineral Rubber, "Rupron."—£20 per ton.

Sulphur Chloride.—7d. per lb.

Vegetable Lamp Black.—£49 per ton.

Vermillion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.

Nitrogen Fertilisers

Ammonium Phosphate.—Not quoted—temporarily unobtainable.

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, in January, £10 6s. 6d., rising by 1s. 6d. per ton per month to March, 1949.

Calcium Cyanamide.—Nominal; supplies very scanty.

Compound Fertilisers.—Per ton d/d farmer's nearest station, I.C.I. No. 1 grade, where available, £10 14s. 6d. I.C.I. Special No. 1, £16 11s., rising by 2s. 6d. per ton per month to March, 1949.

"Nitro-Chalk."—£10 4s. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean for 6-ton lots d/d nearest station, £11 per ton.

Coal-Tar Products

Benzol.—Per gal. ex works: 90's, 2s. 6d.; pure, 2s. 8½d.; nitration grade, 2s. 10½d.

Carbolic Acid. — Crystals, 11½d per lb. Crude, 60's, 4s. 3d. MANCHESTER: Crystals, 10¾d. to 1s. 0½d. per lb., d/d crude, 4s. 3d., naked, at works.

Creosote.—Home trade, 6¼d. to 9¾d. per gal., according to quality, f.o.r. maker's works. MANCHESTER: 6¼d. to 9¾d. per gal.

Cresylic Acid.—Pale, 98%, 3s. 9d per gal.; 99%, 4s. 2d.; 99.5/100%, 4s. 4d. American, duty free, 4s. 2d., naked at works. MANCHESTER: Pale, 99/100%, 4s. 4d. per gal.

Naphtha.—Solvent, 90/160°, 2s. 10d. per gal. for 1000-gal. lots; heavy, 90/190°, 2s. 4d. per gal. for 1000-gal. lots, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Naphthalene.—Crude, ton lots, in sellers' bags, £8 1s. to £12 13s. per ton according to m.p.; hot-pressed, £14 15s. to £15 14s. per ton, in bulk ex works; purified crystals, £28 to £43 5s. per ton. Controlled prices.

Pitch.—Medium, soft, home trade, 100s. per ton f.o.r. suppliers' works; export trade, £8 5s. to £9 5s. per ton f.o.b. suppliers' port. MANCHESTER: 100s. f.o.r.

Pyridine.—90/140°, 21s. 6d. to 22s. 6d. per gal.; 90/160°, 19s. MANCHESTER: 19s. 6d. to 22s. 6d. per gal.

Toluol.—Pure, 3s. 2½d. per gal.; 90's, 2s. 4d. per gal. MANCHESTER: Pure, 3s. 2½d. per gal. naked.

Xylol.—For 1000-gal. lots, 3s. 3½d. to 3s. 6d. per gal., according to grade, d/d.

Wood Distillation Products

Calcium Acetate.—Brown, £15 per ton; grey, £22.

Methyl Acetone.—40/50%, £56 to £60 per ton.

Wood Creosote.—Unrefined, from 3s. 6d per gal., according to boiling range.

Wood Naphtha.—Miscible, 4s. 6d to 5s. 6d. per gal.; solvent, 5s. 6d. to 6s. 6d. per gal.

Wood Tar.—£6 to £10 per ton.

Intermediates and Dyes (Prices Nominal)

***m*-Cresol** 98/100%.—Nominal.

***o*-Cresol** 30/31° C.—Nominal.

***p*-Cresol** 34/35° C.—Nominal.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—8½d. per lb.

Dinitrotoluene.—48/50° C., 9½d. per lb.; 66/68° C., 1s.

***p*-Nitraniline.**—2s. 5d. per lb

Nitrobenzene.—Spot, 5½d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyers' works.

Nitronaphthalene.—1s. 2d. per lb.; P.G. 1s. 0½d. per lb.

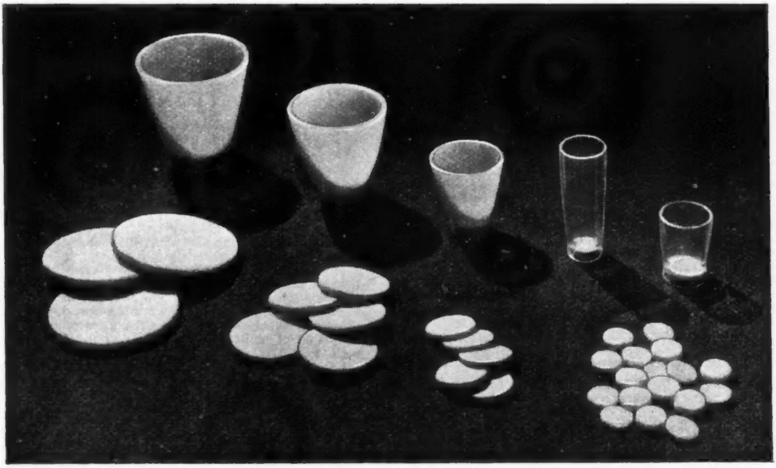
***o*-Toluidine.**—1s. per lb., in 8/10-cwt. drums, drums extra.

***p*-Toluidine.**—2s. 2d. per lb., in casks.

***m*-Xylidine Acetate.**—4s. 5d. per lb., 100%.

Latest Oil Prices

LONDON.—April 27.—The prices of LINSEED, RAPESEED, COCONUT, PALM KERNEL, GROUNDNUT and WHALE OILS, as well as ACID OILS, are unchanged (THE CHEMICAL AGE, March 26, 1949). These prices continue for periods ending May 7 in respect of unrefined oils, and May 21 for refined oils. ROSIN and TURPENTINE prices remain the same, according to grade.



CLASSIFIED ADVERTISEMENTS

FOR SALE

GEORGE 600 COHEN'S

BUELL (Buttner System) **ROTARY DRYING PLANT,** comprising rotary drier, 34 ft. 6 in. long by 6 ft. 11 in. diam., constructed $\frac{3}{8}$ in. M.S. plate, with discharge equipment, fan, dust separator system, screw and drag link conveyors, bucket elevators, excluding electrical equipment.

Twelve—60-gallon Stainless Steel Water-jacketed **MIXERS**; geared motor stirring units; jacket fitted immersion heaters, thermostatically controlled.

Several—**COMPOUND BALL/TUBE MILLS** by Wm. Johnson. Dimensions, approx. 12 ft. long by 3 ft. 6 in. diam., arranged for belt drive through gearing; complete with charge of flint and steel balls.

Pyramid **HEAT SEALING MACHINE** by A. H. Bland, with electrically heated platens, 10 in. long by $\frac{3}{4}$ in. wide; foot-operated closing.

POWDER SIFTER and MIXER by Barron; trough, 2 ft. 6 in. by 1 ft. 6 in. by 1 ft. 6 in. deep, with detachable bottom; brush-type sifter chain driven, mounted over.

Two—Vertical Open-top Pitch Pine **VATS** by Carty, 6 ft. diam. by 6 ft. deep; loose timber covers.

Three—Unused Broadbent **CENTRIFUGAL HYDRO EXTRACTORS** with 48-in. diam. Staybrite steel baskets, perforated type, direct underdriven (pit type) from vertical spindle motor 420v. D.C., 950 r.p.m.; monitor casing M.S., Staybrite gauze lining to baskets.

Two—**HYDRO EXTRACTORS** by Broadbent, 48 in. diam., perforated baskets; three-point suspension, steam driven.

ROTARY KILN or CALCINER, 51 ft. long by 7 ft. diam. constructed $\frac{1}{2}$-in. plate with 6-in. brick lining, driven by 25 h.p. motor; calciner complete with combustion chamber, twin prior stokers, rotary feed table and fan, all motorised.

MULTI-TUBULAR DRIER by Simon, size 3C; capacity, $4\frac{1}{2}$ tons per hour, with moisture-reduction of 10 per cent, using steam at 100 lb. p.s.i.; trough, 12 ft. long by 6 ft. wide by approx. 6 ft. deep; internal reel of solid drawn steel tubes rotates by ratio of 1 : 4.

Three—**TWIN RUMBLING BARRELS,** hexagonal oil barrels, 2 ft. 9 in. long by 18 in. across flats; steel framework; units belt driven from 1 h.p. motor, 480/3/50.

GEORGE COHEN SONS & CO. LTD.,
SUNBEAM ROAD, LONDON, N.W.10.
Tel.: Elgar 7222 and
STANNINGLEY, Nr. LEEDS.
Tel.: Pudsey 2241.

NEW STAINLESS STEEL PLANT FOR ALL NEEDS

with quick delivery

Boiling Pans, Tanks of all shapes and sizes
Dyeing and **Drying Racks**
Stainless Steel Buckets
Steam heated vacuum Driers
Acid resisting enamelled ware

We also specialise in finding unusual second-hand items for our customers. If you do not receive our Monthly List please let us have your address. We are not dealers but sell plant on commission. May we help you?

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Chemical Engineer
Manor House, Barwick-in-Elmet, Leeds
Tel. Barwick-in-Elmet 216

FOR SALE

MORTON, SON & WARD LIMITED,
— OFFER —
SELECTED ITEMS FROM STOCK

ONE—60 in. Broadbent all-electric Hydro Extractor with perforated galvanised steel plate cage. Three point suspension, complete with Allen West starting gear, all electrical equipment for 400/3/50 cycles supply.

THREE—200 gallon rectangular stainless Tanks, open top 4 ft. 6 in. by 3 ft. 6 in. by 2 ft. deep, constructed 12 gauge FDP quality polished plate with smooth rounded corners and 3 in. folded rim around top. Tanks arranged in timber cradles giving full support to bottom and sides.

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ONE—New and unused Gardner "Rapid" steam jacketed Mixer and Dryer, 2 ft. 3 in. wide by 2 ft. 6 in. deep by 6 ft. 3 in. long, gear wheel and pinion drive from F. & L. pulleys.

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1—30′ × 7′ dia.
1—20′ × 5′ dia.
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SET of Rubber or Plastic Rolls, Steam Heated, 16 in. by 9 ft. dia.
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STEEL TANKS AND VESSELS
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20—3′ 9″ dia. × 6′ long
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1—25′ × 8′ 6″ × 6′ deep
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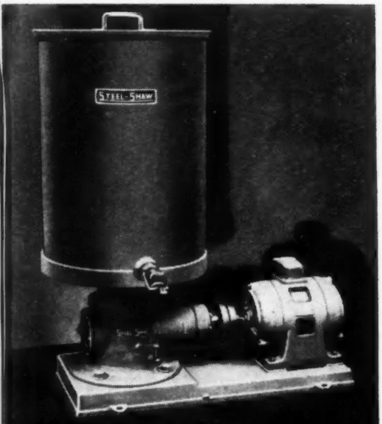

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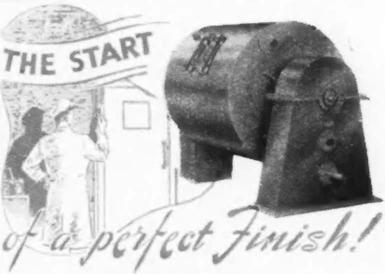

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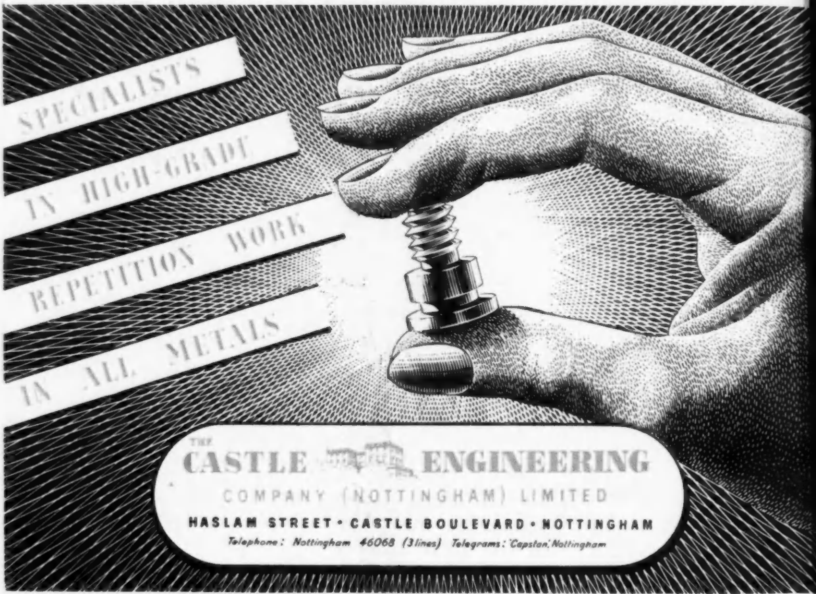

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